GAS SEPARATOR FOR FUEL CELL AND THE FUEL CELL, AND GAS DISTRIBUTING METHOD FOR FUEL CELL

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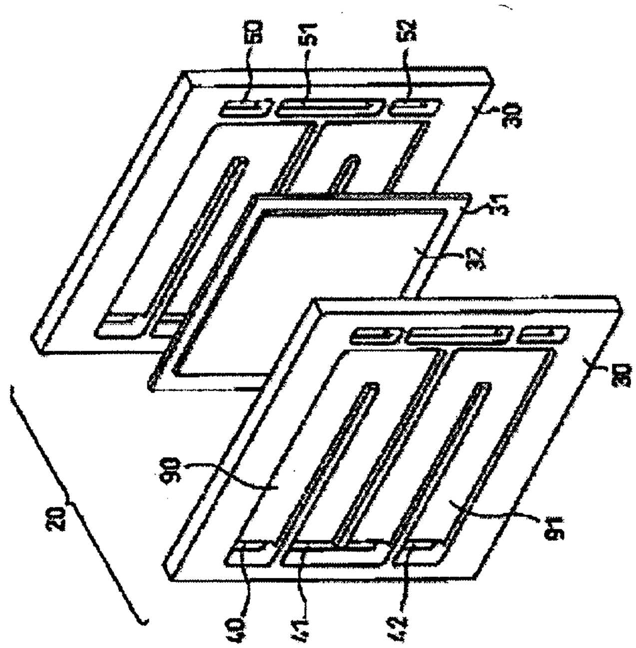
Abstract of **JP2000082482**
PROBLEM TO BE SOLVED: To prevent flow rate of gas passing through each cell from becaming nonuniform, resulting in deterioration of cell performance. SOLUTION: A separator 30 has holes 40, 41, 42 and recesses 90, 91 formed on one face. These recesses define an in-cell oxidizing gas flow passage in a space to an anode. Oxidizing gas to be supplied from the outside to a fuel cell is distributed from a oxidizing gas supply manifold defined by the hole 40, passing through the in-cell oxidizing gas flow passage defined by the recesses 90, 91 collected in an oxidizing gas exhaust manifold defined by the hole 42 and exhausted to the outside. In this case, the oxidizing gas passing through the in-cell oxidizing gas flow passage is passed via an oxidizing gas distributing manifold formed by the hole 41.



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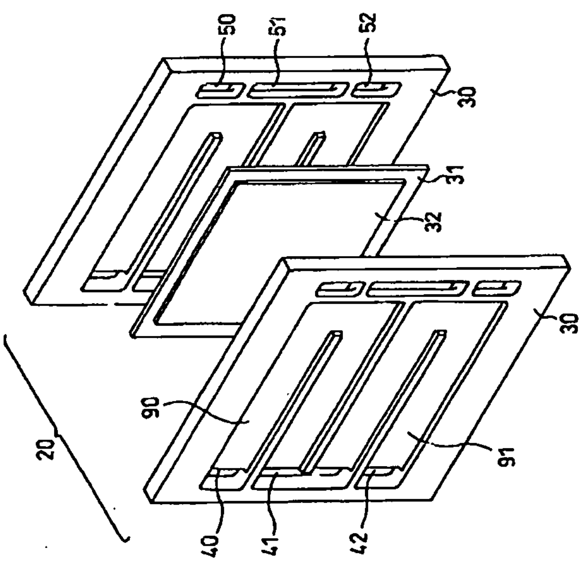
(54)【発明の名称】　燃料電池用ガスセパレータおよび燃料電池並びに燃料電池におけるガスの流通方法

(57)【要約】
【課題】　各単セル内を通過するガスの流量が不均一となって電池性能が低下してしまうのを防止する。
【解決手段】　セパレータ３０は、孔部４０，４１，４２を備え、また、その一方の面上には、凹部９０，９１が形成されている。セパレータ３０を用いて組み立てた燃料電池では、これらの凹部は、アノード３３との間で単セル内酸化ガス流路を形成する。外部から燃料電池に供給される酸化ガスは、孔部４０が形成する酸化ガス供給マニホールドから分配されて、凹部９０，９１が形成する単セル内酸化ガス流路を通過し、孔部４２が形成する酸化ガス排出マニホールドに集まって外部に排出される。その際、各単セル内酸化ガス流路を通過する酸化ガスは、孔部４１が形成する酸化ガス配流マニホールドを経由する。



【特許請求の範囲】

【請求項1】　単セルを複数積層してなり、各単セルにおいてガスを利用した電気化学反応によって起電力を得る燃料電池であって、
前記各単セル内にそれぞれ連続して設けられ、前記ガスを通過させて該ガスを前記各単セル内に行き渡らせるための単セル内ガス流路と、
前記燃料電池の外部から流入される前記ガスを分配して、それぞれの前記単セル内ガス流路に供給するガス供給マニホールドと、
それぞれの前記単セル内ガス流路から排出される前記ガスを集めて、前記燃料電池の外部に流出させるガス排出マニホールドと、
前記単セルの積層方向に、前記各単セル内ガス流路をそれぞれ貫通して、前記各単セル内ガス流路間の前記ガスの行き来を可能にする配流マニホールドとを備える燃料電池。

【請求項2】　前記配流マニホールドを複数備える請求項1記載の燃料電池。

【請求項3】　前記ガスは、水素を含有する燃料ガスである請求項1または2記載の燃料電池。

【請求項4】　前記ガスは、酸素を含有する酸化ガスである請求項1または2記載の燃料電池。

【請求項5】　請求項1記載の燃料電池であって、
前記単セル内ガス流路は、内部を通過する前記ガスの流れの方向を変更するように流路が屈曲する折れ曲がり部を有し、
前記折れ曲がり部は、
前記配流マニホールドが貫通する第1の領域と、
前記折れ曲がり部の内部を通過する前記ガスの一部を、前記配流マニホールドを介することなく通過可能にする第2の領域とを備える燃料電池。

【請求項6】　前記折れ曲がり部は、U字形を成している請求項5記載の燃料電池。

【請求項7】　請求項1記載の燃料電池であって、
前記単セル内ガス流路は、その内部を通過する前記ガスの流れの方向を変更するように流路が屈曲する折れ曲がり部を有し、
前記折れ曲がり部の外周は、滑らかに湾曲するよう形成され、
前記配流マニホールドは、前記折れ曲がり部の外周部において、前記単セル内ガス流路を貫通する燃料電池。

【請求項8】　請求項1記載の燃料電池であって、
前記単セル内ガス流路は、その内部を通過する前記ガスの流れの方向を変更するように流路が屈曲する折れ曲がり部を、前記燃料電池の外縁近くに有し、
前記配流マニホールドは、前記燃料電池の外縁近くに設けられると共に、前記折れ曲がり部の外周部において、前記単セル内ガス流路を貫通し、
前記配流マニホールドの断面形状は、前記燃料電池の外縁に沿った縦長形状を成し、
前記配流マニホールドにおける前記燃料電池外縁側の内壁面のうち、縦長形状を成す前記断面形状の端部に対応する内壁面は、前記断面形状の中央部に対応する内壁面に比べて、前記燃料電池の外縁からの厚さが厚いことを特徴とする燃料電池。

【請求項9】　複数の単セルを積層してなる燃料電池に用いられ、電解質層および電極を形成する部材と共に前記単セルを構成する燃料電池用ガスセパレータであって、
該燃料電池用ガスセパレータをその厚み方向にそれぞれ貫通して設けられ、前記燃料電池のガスマニホールドの一部をそれぞれ形成するための3つ以上の孔と、
前記燃料電池用ガスセパレータの一方の面上において、前記3つ以上の孔のうち、所定の第1の孔から所定の第2の孔まで、該第1および第2の孔以外の孔を順次介しながら、前記面上を連通させるように設けられ、前記単セル内のガス流路を形成するための凹部とを備えることを特徴とする燃料電池用ガスセパレータ。

【請求項10】　請求項9記載の燃料電池用ガスセパレータであって、
前記凹部は、前記所定の第1の孔から第2の孔までを、前記燃料電池用ガスセパレータの一方の面上において連通させる途中に、該一方の面上で屈曲する折れ曲がり部を備え、
前記折れ曲がり部は、
前記第1および第2の孔以外の孔の一つが貫通する第1の領域と、
該第1の領域を貫通する前記孔に分断されることなく、前記凹部の底面が連続して形成される第2の領域とを備える燃料電池用ガスセパレータ。

【請求項11】　請求項9記載の燃料電池用ガスセパレータであって、
前記凹部は、前記所定の第1の孔から第2の孔までを、前記燃料電池用ガスセパレータの一方の面上において連通させる途中に、該一方の面上で屈曲する折れ曲がり部を、前記燃料電池用ガスセパレータの外縁近くに有し、
前記第1および第2の孔以外の孔の一つは、
前記燃料電池用ガスセパレータの外縁近くに配設されて、前記燃料電池用ガスセパレータの外縁に沿った縦長形状を成すと共に、前記折れ曲がり部の外周部において、前記凹部を貫通し、
該孔を形成する壁面のうち、前記燃料電池用ガスセパレータの外縁側に位置する壁面は、縦長形状を成す前記孔の端部に対応する部分が、中央部に対応する部分に比べて、前記燃料電池用ガスセパレータの外縁からの距離が大きくなるよう形成されていることを特徴とする燃料電池用ガスセパレータ。

【請求項12】　単セルを複数積層してなり、ガスの供給を受けて、該ガスを利用した電気化学反応によって起

電力を得る燃料電池におけるガスの流通方法であって、
（ａ）前記燃料電池外部から供給された前記ガスを、前記燃料電池に設けられたガス供給マニホールドを介して、各々の前記単セル内部に形成された単セル内ガス流路に分配する工程と、
（ｂ）各々の前記単セルにおいて、前記ガス供給マニホールドから分配された前記ガスを、前記単セル内ガス流路に通過させつつ、各々の前記単セルで進行する電気化学反応に供する工程と、
（ｃ）前記電気化学反応に供された後に各々の前記単セル内ガス流路から排出された前記ガスを、前記燃料電池に設けられたガス排出マニホールドに集合させ、該集合したガスを前記燃料電池外に排出する工程とを備え、
（ｂ－１）前記（ｂ）工程は、各々の前記単セルにおいて、前記単セル内ガス流路を通過する前記ガスの少なくとも一部を、前記燃料電池内部において前記単セルの積層方向に貫通して設けられた配流マニホールドを経由させる工程をさらに備える燃料電池におけるガスの流通方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、燃料電池用ガスセパレータおよび燃料電池並びに燃料電池におけるガスの流通方法に関し、詳しくは、単セルを複数積層して構成する燃料電池において、隣接する単セル間に設けられ、隣接する部材との間で燃料ガス流路および酸化ガス流路を形成すると共に、燃料ガスと酸化ガスとを隔てる燃料電池用セパレータ、および該セパレータを用いた燃料電池、並びに該燃料電池におけるガスの流通方法に関する。

【０００２】

【従来の技術】燃料電池用ガスセパレータは、複数の単セルが積層された燃料電池スタックを構成する部材であって、充分なガス不透過性を備えることによって、隣り合う単セルのそれぞれに供給される燃料ガスおよび酸化ガスが混じり合うのを防いでいる。このような燃料電池用セパレータは、通常は表面にリブ状などの凹凸構造を有しており、燃料ガスおよび酸化ガスの流路を形成する働きも有している（このような構成のガスセパレータは、リブ付きインターコネクタとも呼ばれる）。すなわち、燃料電池用セパレータは、燃料電池スタックに組み込まれたときには、隣接する部材（ガス拡散層）と上記凹凸構造との間で、燃料ガスまたは酸化ガスの流路（単セル内ガス流路）を形成する。

【０００３】また、燃料電池用ガスセパレータは、通常は、上記したガス流路を形成する凹凸構造の他に、所定の孔構造を有している。このようなガスセパレータを備える単セルを積層して燃料電池スタックを構成したときには、隣り合うガスセパレータに備えられた対応する孔構造同士が重なって、これらの孔構造によって、燃料電池スタック内をその積層方向に貫くガスマニホールドが形成される。このようなガスマニホールドは、燃料電池の外部から供給される燃料ガスまたは酸化ガスをその内部に通過させつつ各単セルに分配したり、各単セルで電気化学反応に供された後の燃料排ガスあるいは酸化排ガスを集合させてこれらを燃料電池外部に流出させたりする。したがって、上記孔構造によって形成されるガスマニホールドは、積層された各単セル内に形成される上記単セル内ガス流路（単セル内酸化ガス流路または単セル内燃料ガス流路）と連通しており、ガスマニホールドと単セル内流路との間でガスが流出入可能となっている。

【０００４】図１８は、従来知られる燃料電池用ガスセパレータの一例として、セパレータ９３０の構成を平面的に表わす説明図である。セパレータ９３０は、その周辺近くに、４つの孔構造として、孔部９４０，９４２，９５０，９５２を備えている。これらの孔部は、セパレータ９３０を含む部材からなる単セルを複数個積層して燃料電池を構成する際には、隣り合うセパレータ９３０が備える対応する孔部同士が重なって、燃料電池の内部で、それぞれ、酸化ガス供給マニホールド（外部から供給される酸化ガスを各単セル内酸化ガス流路に分配する）、酸化ガス排出マニホールド（各単セル内酸化ガス流路から排出される酸化排ガスを集合させて燃料電池外に導く）、燃料ガス供給マニホールド（外部から供給される燃料ガスを各単セル内燃料ガス流路に分配する）、燃料ガス排出マニホールド（各単セル内燃料ガス流路から排出される燃料排ガスを集合させて燃料電池外に導く）を形成する。

【０００５】また、セパレータ９３０の一方の面には、孔部９４０と孔部９４２とを連通させる凹部９９０が設けられており、セパレータ９３０の他方の面には、孔部９５０と孔部９５２とを連通させる凹部（図示せず）が設けられている。これらの凹部は共に、途中２カ所の屈曲部を有する溝状構造となっている。セパレータ９３０を含む部材を積層して燃料電池を構成する際には、これらの凹部は、セパレータ９３０に隣接する部材との間で、単セル内ガス流路を形成する。すなわち、孔部９４０と孔部９４２とを連通させる凹部９９０は、単セル内酸化ガス流路を形成し、孔部９５０と孔部９５２とを連通させる凹部は、単セル内燃料ガス流路を形成する。燃料電池に供給された酸化ガスは、孔部９４０によって形成される酸化ガス供給マニホールド内を通過し、各単セル内に形成された単セル内酸化ガス流路に分配され、電気化学反応に供された後に、孔部９４２によって形成される酸化ガス排出マニホールドで合流して、燃料電池外部に排出される。同様に、燃料電池に供給された燃料ガスは、孔部９５０によって形成される燃料ガス供給マニホールド内を通過し、各単セル内に形成された単セル内燃料ガス流路に分配され、電気化学反応に供された後に、孔部９５２によって形成される燃料ガス排出マニホ

ールドで合流して、燃料電池外部に排出される。

【0006】特に、このような図18に示したセパレータ930では、セパレータ930のそれぞれの面上に設けられた凹部が、一往復半だけ屈曲する形状となっているため、このように屈曲する形状にしない場合に比べて、単セル内ガス流路の流路断面が小さくなり、流路の任意の場所を通過するガスの流速をより速くすることができる。したがって、単セル内ガス流路内を通過するガスが、流路内でよりよく撹拌され、拡散する状態となる。このような状態となることによって、ガス（燃料ガスあるいは酸化ガス）中の電極活物質（水素あるいは酸素）が、電極上に設けられた触媒層と接触し易くなると共に、電極活物質が電気化学反応で利用され易くなり、ガスの利用率が向上する。

【0007】図18に示した構成の他に、燃料電池用ガスセパレータの表面に設けられた凹部の形状として、上記したように一往復半だけ屈曲した形状の凹部を、同一平面上において各々平行に複数個設け、これら同一面上の複数の凹部に対して、ガス供給マニホールドおよびガス排出マニホールドを形成する一対のガス導入孔およびガス排出孔を介して、ガスの給排を行なう構成が提案されている（例えば、特開平7－263003号公報等）。このような構成とすれば、屈曲した形状の凹部を同一平面上に複数個設けることにより、単セル内ガス流路の流路断面がさらに小さくなり、流路内の任意の場所を通過するガスの流速がより速くなるため、燃料電池におけるガスの利用率をさらに向上させることができる。

【0008】

【発明が解決しようとする課題】しかしながら、上記した図18および公報に開示された燃料電池用ガスセパレータでは、各々の単セルが備える単セル内ガス流路において、この単セル内ガス流路に供給されるガスが通過する孔（図18では孔部940および孔部950）、および、単セル内ガス流路から排出されるガスが通過する孔（図18では孔部942および孔部952）が、それぞれ一つずつしかないため、燃料電池を構成する各々の単セルに対するガスの配流が不均一になってしまうおそれがあるという問題があった。例えば、電気化学反応に伴って生じる生成水などがガスの流路内で凝縮した場合に、この凝縮水が、ガスマニホールドと単セル内ガス流路との接続部付近や、単セル内ガス流路内に滞留してしまうと、この凝縮水が滞留した部位に対応する単セル内ガス流路においてガスの流れに対する抵抗が生じ、ガスの流れが妨げられてしまう。このようにガスの供給状態が悪化した単セルでは、電気化学反応が充分に進行しなくなるため、燃料電池全体では各単セル間で出力電圧にばらつきが生じてしまい、燃料電池の性能が低下するおそれがある。

【0009】ここで、ガス流路内に生じる凝縮水について説明する。酸化ガスの流路中に生じる凝縮水は、電気化学反応に伴ってカソード側に生じる生成水に起因している。以下に、固体高分子型燃料電池を構成する各単セルで進行する電気化学反応を表わす。

【0010】

$$H_2 \rightarrow 2H^+ + 2e^- \quad \cdots(1)$$

$$(1/2)O_2 + 2H^+ + 2e^- \rightarrow H_2O \quad \cdots(2)$$

$$H_2 + (1/2)O_2 \rightarrow H_2O \quad \cdots(3)$$

【0011】（1）式はアノード側における反応を、（2）式はカソード側における反応を示し、電池全体としては（3）式に示す反応が進行する。このように固体高分子型燃料電池では、電池反応の進行に伴ってカソード側で生成水が生じる。生じた生成水は、カソード側に供給されている酸化ガス中に気化し、酸化ガスとともに燃料電池外に排出されるが、生成水量が多いときや、酸化ガスが流れる流路中に部分的に温度が低い領域があると、酸化ガスの流路内で生成水が凝縮し、凝縮水が流路内に滞留してしまうことがある。

【0012】アノード側では、電気化学反応に伴って生成水が生じることはないが、アノード側に供給される燃料ガスは、通常は、燃料電池に供給するのに先立って予め加湿を行なう。すなわち、アノード側で上記（1）式に示した反応が進行する際、生じたプロトンは、水分子と水和した状態で、固体電解質膜中をカソード側に向かって移動するため、固体電解質のアノード側では水が不足する状態となるが、固体電解質の乾きは固体電解質の導電性を低下させてしまうため、通常は、上記したように予め加湿した燃料ガスを供給することによって、固体電解質膜の乾燥を防いでいる。したがって、この燃料ガスに付加された水蒸気が、燃料ガスの流路内で凝縮してしまうことがある。このように、酸化ガスの流路、あるいは、燃料ガスの流路において生じた凝縮水が滞留し、一部の単セルにおいてガスの供給状態が悪化すると、燃料電池全体の性能が悪化してしまうおそれがある。

【0013】また、燃料電池を構成する各単セル間で出力電圧がばらついてしまうという問題は、上記した凝縮水が原因となる他に、燃料電池用ガスセパレータを成形する際の精度に起因して生じることがある。ガス流路を形成するためにガスセパレータ表面に形成された凹凸構造において、成形の精度が不十分であった場合、すなわち、形成された凹凸の深さにばらつきがあった場合には、各単セルごとに、単セル内ガス流路をガスが通過する際の流路抵抗がばらつき、各単セルごとに供給されるガス量がばらついてしまう。従って、従来知られるガスセパレータを用いた燃料電池では、ガスセパレータを成形する際の精度に起因して、各単セル間で出力電圧がばらついて、燃料電池全体の性能が悪化してしまうおそれがあった。

【0014】本発明の燃料電池用ガスセパレータおよび燃料電池並びに燃料電池におけるガスの流通方法は、こうした問題を解決し、各単セル内を通過するガスの流量が不均一となって電池性能が低下してしまうのを防止することを目的としてなされ、次の構成を採った。

【0015】

【課題を解決するための手段およびその作用・効果】本発明の燃料電池は、単セルを複数積層してなり、各単セルにおいてガスを利用した電気化学反応によって起電力を得る燃料電池であって、前記各単セル内にそれぞれ連続して設けられ、前記ガスを通過させて該ガスを前記各単セル内に行き渡らせるための単セル内ガス流路と、前記燃料電池の外部から流入される前記ガスを分配して、それぞれの前記単セル内ガス流路に供給するガス供給マニホールドと、それぞれの前記単セル内ガス流路から排出される前記ガスを集めて、前記燃料電池の外部に流出させるガス排出マニホールドと、前記単セルの積層方向に、前記各単セル内ガス流路をそれぞれ貫通して、前記各単セル内ガス流路間の前記ガスの行き来を可能にする配流マニホールドとを備えることを要旨とする。

【0016】以上のように構成された本発明の燃料電池は、単セルを複数積層してなり、燃料電池の外部から流入されるガスを、ガス供給マニホールドが分配して、それぞれの単セル内ガス流路に供給する。各単セル内に設けられた単セル内ガス流路は、供給された前記ガスを通過させて、該ガスを各単セル内に行き渡らせる。各単セルでは、このガスを利用した電気化学反応によって起電力を得る。また、燃料電池には、前記単セルの積層方向に、前記各単セル内ガス流路をそれぞれ貫通して、前記各単セル内ガス流路間の前記ガスの行き来を可能にする配流マニホールドが設けられており、前記ガスは、各単セル内ガス流路を通過する際に、この配流マニホールドを経由する。それぞれの前記単セル内ガス流路から排出された前記ガスは、ガス排出マニホールドに集められて、燃料電池の外部に流出される。

【0017】また、本発明の燃料電池におけるガスの流通方法は、単セルを複数積層してなり、ガスの供給を受けて、該ガスを利用した電気化学反応によって起電力を得る燃料電池におけるガスの流通方法であって、（ａ）前記燃料電池外部から供給された前記ガスを、前記燃料電池に設けられたガス供給マニホールドを介して、各々の前記単セル内部に形成された単セル内ガス流路に分配する工程と、（ｂ）各々の前記単セルにおいて、前記ガス供給マニホールドから分配された前記ガスを、前記単セル内ガス流路に通過させつつ、各々の前記単セルで進行する電気化学反応に供する工程と、（ｃ）前記電気化学反応に供された後に各々の前記単セル内ガス流路から排出された前記ガスを、前記燃料電池に設けられたガス排出マニホールドに集合させ、該集合したガスを前記燃料電池外に排出する工程とを備え、（ｂ－１）前記（ｂ）工程は、各々の前記単セルにおいて、前記単セル内ガス流路を通過する前記ガスの少なくとも一部を、前記燃料電池内部において前記単セルの積層方向に貫通して設けられた配流マニホールドを経由させる工程をさらに備えることを要旨とする。

【0018】このような本発明の燃料電池、および、本発明の燃料電池におけるガスの流通方法によれば、単セル内ガス流路を通過するガスが、配流マニホールドを経由するため、燃料電池を構成する単セルのいずれかにおいて、ガスの供給状態が悪化することにより出力電圧が低下し、燃料電池全体の性能が低下してしまうのを防止することができる。すなわち、単セルのいずれかにおいて、凝縮水の滞留などによって、単セル内ガス流路にガスが流入する際の流路抵抗が増大し、ガスの供給状態が悪化した場合にも、単セル内ガス流路を通過するガスが配流マニホールドを経由することによって、この配流マニホールドとの接続部よりも下流側の単セル内ガス流路では、ガスの供給量を充分に確保することが可能となる。したがって、凝縮水の滞留などが起こっても、この凝縮水が滞留した単セル全体においてガスの供給状態が悪化してしまうことがない。

【0019】さらに、本発明の燃料電池、および、本発明の燃料電池におけるガスの流通方法によれば、それぞれの単セル内ガス流路を通過するガスが、配流マニホールドを経由するため、燃料電池全体で、それぞれの単セル内ガス流路を通過するガスの流量（あるいは流速）を均一化することができるという効果を奏する。配流マニホールドでは、各単セル内ガス流路間のガスの行き来が可能となっているため、各単セル内ガス流路を通過するガスの流量にばらつきがある場合には、それらは均一化される。また、燃料電池の内部では、外部から給排されるガスの流れの方向（ガス排出マニホールド内を通過するガスの流れの方向）に応じて、それぞれの単セル内を通過するガス流量に、所定の勾配が生じる。本発明の燃料電池、および、本発明の燃料電池におけるガスの流通方法のように、配流マニホールドを設けてそれぞれの単セル内ガス流路を通過するガス流量を均一化すると、上記した勾配を小さくすることができるため、燃料電池全体を構成するそれぞれの単セルで、ガスの流量を充分に確保することができ、それぞれの単セルで進行する電気化学反応量を高いレベルに維持することができる。

【0020】本発明の燃料電池は、前記配流マニホールドを複数備えることとしても良い。このような構成とすれば、凝縮水などに起因して、所定の単セルにおいてガスの供給が妨げられることによる影響を削減すると共に、各単セル内ガス流路を通過するガスの流量を均一化する効果をさらに高めることができる。

【0021】本発明の燃料電池において、前記ガスは、水素を含有する燃料ガスであることとしても良い。このような構成とすれば、燃料電池内に形成された燃料ガス

の流路において、上記した効果を得ることができ、燃料電池の電池性能（安定した出力電圧）を充分に高く維持することができる。

【0022】また、本発明の燃料電池において、前記ガスは、酸素を含有する酸化ガスであることとしても良い。このような構成とすれば、燃料電池内に形成された酸化ガスの流路において、上記した効果を得ることができ、燃料電池の電池性能（安定した出力電圧）を充分に高く維持することができる。

【0023】本発明の燃料電池用ガスセパレータは、複数の単セルを積層してなる燃料電池に用いられ、電解質層および電極を形成する部材と共に前記単セルを構成する燃料電池用ガスセパレータであって、該燃料電池用ガスセパレータをその厚み方向にそれぞれ貫通して設けられ、前記燃料電池のガスマニホールドの一部をそれぞれ形成するための３つ以上の孔と、前記燃料電池用ガスセパレータの一方の面上において、前記３つ以上の孔のうち、所定の第１の孔から所定の第２の孔まで、該第１および第２の孔以外の孔を順次介しながら、前記面上を連通させるように設けられ、前記単セル内のガス流路を形成するための凹部とを備えることを要旨とする。

【0024】このような燃料電池用ガスセパレータは、その厚み方向に貫通して設けられた３つ以上の孔を有しており、電解質層および電極を形成する部材と共に単セルを構成し、複数の単セルを積層して構成する燃料電池に用いる。本発明の燃料電池用ガスセパレータを用いて燃料電池を構成したときには、前記３つ以上の孔は、前記燃料電池のガスマニホールドをそれぞれ形成する。また、本発明の燃料電池用ガスセパレータは、その一方の面上に、前記３つ以上の孔のうち、所定の第１の孔から所定の第２の孔まで、該第１および第２の孔以外の孔を順次介しながら、前記面上を連通させる凹部を有している。本発明の燃料電池用ガスセパレータを用いて燃料電池を構成したときには、この凹部は、隣接する部材との間で単セル内のガス流路を形成する。また、この凹部によって形成される単セル内のガス流路は、前記３つ以上の孔のそれぞれによって形成されるガスマニホールドと連通する。このような燃料電池において、所定の第１の孔によって形成されるガスマニホールドに対して、燃料電池の外部からガスを供給すると、供給されたガスは、このガスマニホールドからそれぞれの単セル内のガス流路に分配される。このとき、単セル内のガス流路を通過して排出されるガスは、所定の第２の孔によって形成されるガスマニホールドに集められ、燃料電池外部に流出させることができる。このように単セル内のガス流路をガスが通過する際には、このガスは、前記第１および第２の孔以外の孔によって形成されるガスマニホールドを経由する。

【0025】このような燃料電池用ガスセパレータによれば、本発明の燃料電池と同様の燃料電池を構成することができ、このような燃料電池において、本発明の燃料電池と同様の効果を得ることができる。従って、本発明の燃料電池用ガスセパレータを用いることにより、燃料電池を構成する単セルのいずれかにおいて、ガスの供給状態が悪化することにより出力電圧が低下し、燃料電池全体の性能が低下してしまうおそれのない燃料電池を構成することができる。また、本発明の燃料電池用ガスセパレータを用いることにより、各単セル内ガス流路を通過するガスの流量を均一化すると共に、燃料電池全体を構成するそれぞれの単セルでガスの流量を充分に確保し、それぞれの単セルで進行する電気化学反応量を高いレベルに維持可能な燃料電池を構成することができる。

【0026】なお、本発明の燃料電池用ガスセパレータの表面に形成された前記凹部は、平坦な凹面を形成している必要はなく、凹面から突出する凸部を備えていても良く、所定の第１の孔から所定の第２の孔まで、該第１および第２の孔以外の孔を順次介しながら、燃料電池用ガスセパレータの面上を連通させる構造であればよい。

【0027】本発明の燃料電池において、前記単セル内ガス流路は、内部を通過する前記ガスの流れの方向を変更するように流路が屈曲する折れ曲がり部を有し、前記折れ曲がり部は、前記配流マニホールドが貫通する第１の領域と、前記折れ曲がり部の内部を通過する前記ガスの一部を、前記配流マニホールドを介することなく通過可能にする第２の領域とを備えることとしてもよい。

【0028】このような燃料電池では、単セル内ガス流路を通過するガスは、この単セル内ガス流路が屈曲する折れ曲がり部を通過する際に、その一部は、配流マニホールドを経由し、残りは、配流マニホールドを経由しない。このように、配流マニホールドを経由しない第２の領域を設けることで、配流マニホールドが貫通する折れ曲がり部において、充分な流路幅を確保することができ、上記折れ曲がり部をガスが通過する際の圧損を抑え、ガスの流れをよりスムーズにすることができる。

【0029】また、本発明の燃料電池用ガスセパレータにおいて、前記凹部は、前記所定の第１の孔から第２の孔までを、前記燃料電池用ガスセパレータの一方の面上において連通させる途中に、該一方の面上で屈曲する折れ曲がり部を備え、前記折れ曲がり部は、前記第１および第２の孔以外の孔の一つが貫通する第１の領域と、該第１の領域を貫通する前記孔に分断されることなく、前記凹部の底面が連続して形成される第２の領域とを備えることとしてもよい。

【0030】以上のように構成された燃料電池用ガスセパレータによれば、上記した燃料電池と同様の燃料電池を構成することができ、このような燃料電池において、上記した燃料電池と同様の効果を得ることができる。

【0031】また、上記した燃料電池において、さらに、前記折れ曲がり部は、U字形を成していることとしてもよい。折れ曲がり部をU字形に形成することで、各

単セル内において効果的に単セル内ガス流路を配設して、流路内を通過するガス流量を増やすことができるが、U字形を成す折れ曲がり部では、ガスの流れの方向が逆向きに変更されることにより特に圧損が大きくなり、上記構成とすることで、圧損を軽減してガスの流れをスムーズにする効果を特に顕著に得ることができる。

【0032】また、本発明の燃料電池において、前記単セル内ガス流路は、その内部を通過する前記ガスの流れの方向を変更するように流路が屈曲する折れ曲がり部を有し、前記折れ曲がり部の外周は、滑らかに湾曲するよう形成され、前記配流マニホールドは、前記折れ曲がり部の外周部において、前記単セル内ガス流路を貫通することとしてもよい。

【0033】このような構成とすれば、単セル内ガス流路を通過するガスが、折れ曲がり部において、滑らかに湾曲する外周に導かれて流れるため、単セル内ガス流路を通過するガスの流れがよりスムーズになるという効果が得られる。

【0034】さらに、本発明の燃料電池において、前記単セル内ガス流路は、その内部を通過する前記ガスの流れの方向を変更するように流路が屈曲する折れ曲がり部を、前記燃料電池の外縁近くに有し、前記配流マニホールドは、前記燃料電池の外縁近くに設けられると共に、前記折れ曲がり部の外周部において、前記単セル内ガス流路を貫通し、前記配流マニホールドの断面形状は、前記燃料電池の外縁に沿った縦長形状を成し、前記配流マニホールドにおける前記燃料電池外縁側の内壁面のうち、縦長形状を成す前記断面形状の端部に対応する内壁面は、前記断面形状の中央部に対応する内壁面に比べて、前記燃料電池の外縁からの厚さが厚いこととしてもよい。

【0035】このような燃料電池によれば、燃料電池の強度および耐久性を充分に確保することができる。配流マニホールドを燃料電池の外縁近くに設け、配流マニホールドの断面形状が、燃料電池の外縁に沿った縦長形状とすることによって、配流マニホールドを設けることで各単セル内で電気化学反応に関与できる領域が小さくなってしまうのを抑えることができると共に、配流マニホールドにおけるガスシール性を確保するのが容易になる。しかしながら、配流マニホールドが貫通する上記折れ曲がり部において、ガスの流れの方向が変わるため、配流マニホールドの内壁面と燃料電池の外縁との間には、強い応力が働くことになる。この応力は、特に、縦長形状に形成された配流マニホールドの断面の端部に対応する領域において集中することになり、この領域の強度が、燃料電池全体の強度に影響を与えるおそれがある。燃料電池を上記のような構成とすることにより、折れ曲がり部を通過するガスによって強い応力が働く領域の強度を充分に確保することができ、これによって、燃料電池全体の強度を充分に確保することが可能となる。

【0036】また、本発明の燃料電池用ガスセパレータは、前記凹部は、前記所定の第1の孔から第2の孔までを、前記燃料電池用ガスセパレータの一方の面上において連通させる途中に、該一方の面上で屈曲する折れ曲がり部を、前記燃料電池用ガスセパレータの外縁近くに有し、前記第1および第2の孔以外の孔の一つは、前記燃料電池用ガスセパレータの外縁近くに配設されて、前記燃料電池用ガスセパレータの外縁に沿った縦長形状を成すと共に、前記折れ曲がり部の外周部において、前記凹部を貫通し、該孔を形成する壁面のうち、前記燃料電池用ガスセパレータの外縁側に位置する壁面は、縦長形状を成す前記孔の端部に対応する部分が、中央部に対応する部分に比べて、前記燃料電池用ガスセパレータの外縁からの距離が大きくなるよう形成されていることを特徴とすることとしてもよい。

【0037】以上のように構成された燃料電池用ガスセパレータによれば、上記した燃料電池と同様の燃料電池を構成することができ、このような燃料電池において、上記した燃料電池と同様の効果を得ることができる。

【0038】

【発明の実施の形態】以上説明した本発明の構成・作用を一層明らかにするために、以下本発明の実施の形態を実施例に基づき説明する。本発明の第1実施例である燃料電池は、固体高分子型燃料電池であり、単セルを複数積層したスタック構造によって形成されている。図1は、第1実施例の燃料電池を構成するスタック構造15の基本単位である単セル20の構成を表わす分解斜視図、図2は、本実施例の燃料電池が備えるセパレータ30の構成を表わす平面図、図3は、スタック構造15の外観を表わす斜視図である。最初に、図1ないし図3に基づいて、燃料電池の構成を説明し、次に、この燃料電池におけるガスの流れの様子について説明する。

【0039】上述したように、本実施例の燃料電池は、固体高分子型燃料電池であって、基本単位である単セル20を積層したスタック構造15によって構成されている。図1に示すように、単セル20は、電解質膜31，アノード32，カソード33，セパレータ30によって構成されている。

【0040】ここで、電解質膜31は、固体高分子材料、例えばフッ素系樹脂により形成されたプロトン伝導性のイオン交換膜であり、湿潤状態で良好な電気伝導性を示す。本実施例では、ナフィオン膜（デュポン社製）を使用した。電解質膜31の表面には、触媒としての白金または白金と他の金属からなる合金が塗布されている。触媒を塗布する方法としては、白金または白金と他の金属からなる合金を担持したカーボン粉を作製し、この触媒を担持したカーボン粉を適当な有機溶剤に分散させ、電解質溶液（例えば、Aldrich Chemical社、Nafion Solution）を適量添加してペースト化し、電解質膜31上にスクリーン印刷

するという方法をとった。あるいは、上記触媒を担持したカーボン粉を含有するペーストを膜成形してシートを作製し、このシートを電解質膜３１上にプレスする構成も好適である。

【００４１】アノード３２およびカソード３３は、共に炭素繊維からなる糸で織成したカーボンクロスにより形成されたガス拡散電極である。なお、カーボンクロスの他、炭素繊維からなるカーボンペーパまたはカーボンフエルトによって形成しても良く、充分なガス拡散性および導電性を有していればよい。

【００４２】セパレータ３０は、ガス不透過の導電性部材、例えば、カーボンを圧縮してガス不透過とした成形カーボンにより形成されている。図２は、セパレータ３０をその一方の面から見た様子を表わす平面図である。セパレータ３０は、その周辺近くに６個の孔を備えている。すなわち、セパレータ３０の１辺の近傍には、この辺に沿って隣接する３つの孔である孔部４０，４１，４２が設けられており、この辺に対向する辺の近傍には、同じく隣接する孔部５０，５１，５２が設けられている。さらに、セパレータ３０は、その両面に、所定の形状の凹部を備えている。図２に示すように、セパレータ３０の一方の面には、屈曲した形状によって孔部４０および孔部４１を連通させる凹部９０と、同じく屈曲した形状によって孔部４１および孔部４２を連通させる凹部９１とが設けられている。セパレータ３０の他方の面にも、上記一方の面と同様に、屈曲した形状によって孔部５０および孔部５１を連通する凹部９２と、同じく屈曲した形状によって孔部５１および孔部５２を連通する凹部９３とが設けられている（図示せず）。

【００４３】図１に示すように、セパレータ３０が電解質膜３１，アノード３２およびカソード３３と共に積層されて単セル２０を形成し、さらにスタック構造１５を構成するときには、各凹部は、隣接するガス拡散電極との間でガス流路を形成する。すなわち、孔部４０と４１、および孔部４１と４２を連通させる凹部９０および９１は、隣接するカソード３３の表面との間に単セル内酸化ガス流路を形成し、孔部５０と５１、および孔部５１と５２を連通させる凹部９２および９３は、隣接するアノード３２の表面との間に単セル内燃料ガス流路を形成する。

【００４４】単セル２０を積層してスタック構造１５を組み立てたときには、各セパレータ３０が備える孔部４０は、スタック構造１５内部をその積層方向に貫通する酸化ガス供給マニホールド６０を形成する。また、孔部４１は、同じくスタック構造１５内部をその積層方向に貫通する酸化ガス配流マニホールド６１を形成する。また、孔部４２は、同じくスタック構造１５内部をその積層方向に貫通する酸化ガス排出マニホールド６２を形成する。さらに、孔部５０は、同じくスタック構造１５をその積層方向に貫通する燃料ガス供給マニホールド６３を形成し、孔部５１は燃料ガス配流マニホールド６４を形成し、孔部５２は燃料ガス排出マニホールド６５を形成する（図２参照）。スタック構造１５内に形成されたこれらガス流路内でのガスの流れについては、後に詳しく説明する（後述する図５を参照）。

【００４５】以上説明した各部材を備えるスタック構造１５を組み立てるときには、セパレータ３０、アノード３２、電解質膜３１、カソード３３、セパレータ３０の順序で順次重ね合わせる。さらに、その両端に集電板３６，３７、絶縁板３８，３９、エンドプレート８０，８５を順次配置して図３に示すスタック構造１５を完成する。

【００４６】集電板３６，３７は緻密質カーボンや銅板などガス不透過な導電性部材によって形成され、絶縁板３８，３９はゴムや樹脂等の絶縁性部材によって形成され、エンドプレート８０，８５は剛性を備えた鋼等の金属によって形成されている。また、集電板３６，３７にはそれぞれ出力端子３６Ａ，３７Ａが設けられており、スタック構造１５によって構成される燃料電池で生じた起電力を出力可能となっている。なお、集電板３６，絶縁板３８およびエンドプレート８０には、対応する同じ位置に、４つの孔部が設けられている。例えば、エンドプレート８０には、孔部７０，７２，７３，７５が設けられている（図３参照）。孔部７０、および、集電板３６と絶縁板３８においてこれに対応する同じ位置に設けられた孔部は、スタック構造１５を構成したときには、既述した酸化ガス供給マニホールド６０に連通するガス流路を形成する。また、孔部７２、および、集電板３６と絶縁板３８においてこれに対応する同じ位置に設けられた孔部は、スタック構造１５を構成したときには、既述した酸化ガス排出マニホールド６２に連通するガス流路を形成する。同じく、孔部７３、および、集電板３６と絶縁板３８においてこれに対応して設けられた孔部は、燃料ガス供給マニホールド６３に連通するガス流路を形成し、孔部７５、および、集電板３６と絶縁板３８においてこれに対応して設けられた孔部は、燃料ガス排出マニホールド６５に連通するガス流路を形成する。

【００４７】スタック構造１５からなる燃料電池を動作させるときには、エンドプレート８０が備える孔部７３と図示しない燃料ガス供給装置とが接続され、水素リッチな燃料ガスが燃料電池内部に供給される。同様に、燃料電池を動作させるときには、孔部７０と図示しない酸化ガス供給装置とが接続され、酸素を含有する酸化ガス（空気）が燃料電池内部に供給される。ここで、燃料ガス供給装置と酸化ガス供給装置は、それぞれのガスに対して所定量の加湿および加圧を行なって燃料電池に供給する装置である。また、燃料電池を動作させるときには、孔部７５と図示しない燃料ガス排出装置とが接続され、孔部７２と図示しない酸化ガス排出装置とが接続される。なお、燃料ガスとしては、炭化水素を改質して得

た水素リッチガスの他、純度の高い水素ガスを用いることとしても良い。

【0048】スタック構造15を構成するときの各部材の積層順序は既述した通りであるが、電解質膜31の周辺部には、セパレータ30と接する領域において所定のシール部材が設けられる。このシール部材は、各単セル内部から燃料ガスおよび酸化ガスが漏れ出すのを防ぐと共に、スタック構造15内において燃料ガスと酸化ガスとが混合してしまうのを防止する役割を果たす。

【0049】以上説明した各部材からなるスタック構造15は、その積層方向に所定の押圧力がかかった状態で保持され、燃料電池が完成する。スタック構造15を押圧する構成については、本発明の要部とは関わらないため図示は省略した。スタック構造15を押圧しながら保持するには、スタック構造15をボルトとナットを用いて締め付ける構成としても良いし、あるいは所定の形状のスタック収納部材を用意して、このスタック収納部材の内部にスタック構造15を収納した上でスタック収納部材の両端部を折り曲げて、スタック構造15に押圧力を作用させる構成としても良い。

【0050】なお、上記した説明では、セパレータ30は、カーボンを圧縮してガス不透過とした緻密質カーボンによって形成することとしたが、異なる材質によって形成することとしてもよい。例えば、焼成体カーボンによって形成したり、金属部材によって形成することとしてもよい。金属部材によって形成する場合には、充分な耐腐食性を有する金属を選択することが望ましい。あるいは、充分な耐腐食性を有する材料によって、金属部材の表面を被覆することとしてもよい。

【0051】また、図2では記載しなかったが、本実施例のセパレータ30は、酸化ガスが通過するガスマニホールドを形成するための孔部40～42、および、燃料ガスが通過するガスマニホールドを形成するための孔部50～52の他に、冷却水が通過する冷却水路を形成するための孔部も備えている。燃料電池で進行する電気化学反応は発熱反応であり、上記孔部によって形成される冷却水路内に冷却水を循環させることによって、燃料電池内部の温度を所定の温度範囲に保っている。このような冷却水路を形成するための孔部は、セパレータ30において、例えば、孔部40～42および50～52が形成されていない残りの2辺の近傍に設けることができる。冷却水の循環に関する構成は、本発明の要部とは直接関わらないため、冷却水路についてのこれ以上の説明は省略する。

【0052】なお、図1および図2に示したセパレータ30では、単セル内におけるガスの流れをわかりやすくするために、凹部90，91は、底面が平坦な凹構造のように表わしたが、これらの凹部90，91および凹部92，93には、実際には、その底面から突出する所定の形状の複数の凸構造が設けられている。凹部90，91，92，93に設けられたこのような凸構造の一例を図4に示す。図4（A）は、孔部40および凹部90の一部を拡大した様子を表わす平面図であり、図4（B）は、図4（A）におけるA－A断面の様子を表わす断面図である。図4に示すように、凹部90には、その底面から突出する複数の凸部94が設けられている。これらそれぞれの凸部94は、断面が略四角形であり、それぞれの高さが略同一となるように形成されている。それぞれの凸部94の端部は、スタック構造15を組み立てたときには、隣接するカソード33と接し、このカソード33と接する領域によって、燃料電池内部で充分な導電性を確保している。また、単セル内酸化ガス流路を通過する酸化ガスは、それぞれの凸部94の側面に衝突し、単セル内酸化ガス流路で拡散されることによって、電解質膜31表面の触媒層に効率よく供給される。

【0053】このように、凹部90に設けられた凸部94は、その端部でガス拡散電極と接することによって充分な導電性を確保すると共に、凹部90が形成する単セル内ガス流路を通過するガスを拡散して、酸化ガスを効率よく電気化学反応に供し、ガスの利用率を向上させるという働きを有する。また、凹部91，92，93にも、凹部90における凸部94と同様の凸構造が設けられており、同様の働きをしている。なお、図4では、凸部94は、断面略四角形としたが、異なる形状の凸構造を異なる位置に配置することとしても良い。凸部94のようにそれぞれの凹部内に分散して配置するのではなく、それぞれの凹部内に形成する凸構造として、例えば、流路内のガスの流れの方向に沿って連続して設けられたリブ状の凸構造を形成し、それぞれの凹部を、互いに平行に走る細かい溝に分割する構成とすることもできる。セパレータ表面に形成されるそれぞれの凹部は、燃料電池内で単セル内ガス流路を形成したときに、それぞれの凹部が連通させる孔部によって形成されるガスマニホールド間で、ガスが流通可能となっていればよい。

【0054】次に、以上のような構成を備えた燃料電池における燃料ガスおよび酸化ガスの流れについて説明する。最初に、酸化ガスについて説明する。図5は、スタック構造15内での酸化ガスの流れを立体的に表わす説明図である。既述したように、燃料電池外部に設けられた酸化ガス供給装置は、エンドプレート80に設けられた孔部70に接続され、酸化ガス供給装置から供給される酸化ガス（加圧空気）は、絶縁板38および集電板36の対応する位置に設けられた孔部を介して、酸化ガス供給マニホールド60内に導入される。酸化ガス供給マニホールド60内を通過する酸化ガスは、各単セル20において、各セパレータ30が備える凹部90と隣接するカソード33との間で形成されるガス流路（単セル内酸化ガス流路）内に導かれる。これら単セル内酸化ガス流路に導かれた酸化ガスは、単セル内酸化ガス流路から電解質膜31上の触媒層に拡散し、各単セルにおいて電

気化学反応に供される。ここで、電気化学反応に関与しなかった残りの酸化ガスは、セパレータ３０に設けられた孔部４１によって形成される酸化ガス配流マニホールド６１を一旦経由する。

【００５５】酸化ガス配流マニホールド６１では、それぞれの各単セル内ガス流路を通過する酸化ガスが集合して、互いに流通可能となる。また、この酸化ガス配流マニホールド６１では、これら集合した酸化ガスが下向き（図５参照）に流れる。この酸化ガスは、それぞれのセパレータ３０が備える孔部４１を介して、各単セル２０において、各セパレータ３０が備える凹部９１と隣接するカソード３３との間で形成される単セル内酸化ガス流路に導かれる。これら単セル内酸化ガス流路に導かれた酸化ガスは、単セル内酸化ガス流路から電解質膜３１上の触媒層に拡散し、各単セルにおいて電気化学反応に供される。ここで、電気化学反応に関与しなかった残りの酸化ガスは、セパレータ３０に設けられた孔部４２によって形成される酸化ガス排出マニホールド６２に排出される。

【００５６】酸化ガス排出マニホールド６２では、酸化ガス供給マニホールド６０とは逆向きに酸化ガスが通過しながら、各単セル２０内に形成された単セル内酸化ガス流路から排出される酸化ガス同士が合流する。酸化ガス排出マニホールド６２を通過した酸化ガスは、スタック構造１５の端部に達すると、エンドプレート８０に設けられた孔部７２と、集電板３６および絶縁板３８の対応する位置に設けられた孔部とを介して、孔部７２に接続する酸化ガス排出装置に排出される。

【００５７】以上、スタック構造１５内における酸化ガスの流れについて説明したが、スタック構造１５内における燃料ガスの流れについても同様である。燃料電池外部に設けられた燃料ガス供給装置は、エンドプレート８０に設けられた孔部７３に接続され、燃料ガス供給装置から供給される燃料ガスは、絶縁板３８および集電板３６の対応する位置に設けられた孔部を介して、セパレータ３０が備える孔部５０によって形成される燃料ガス供給マニホールド６３内に導入される。燃料ガス供給マニホールド６３内を通過する燃料ガスは、各単セル２０において単セル内燃料ガス流路（凹部９２と隣接するアノード３２との間で形成される）に導かれ、電気化学反応に供される。各単セル２０内の単セル内燃料ガス流路を通過する燃料ガスのうち、電気化学反応に関与しなかった残りのガスは、セパレータ３０に設けられた孔部５１によって形成される燃料ガス配流マニホールド６４を一旦経由する。これら燃料ガス配流マニホールドを経由した燃料ガスは、再び各単セル２０内の単セル内燃料ガス流路（凹部９３と隣接するアノード３２との間で形成される）を通過して、電気化学反応に供される。電気化学反応に関与しなかった残りの燃料ガスは、セパレータ３０に設けられた孔部５２によって形成される燃料ガス排出マニホールド６５に排出されて互いに合流し、燃料ガス排出マニホールド内を、燃料ガス供給マニホールド６３とは逆向きに通過する。このような燃料ガスは、スタック構造１５の端部に達すると、エンドプレート８０に設けられた孔部７５と、集電板３６および絶縁板３８の対応する位置に設けられた孔部とを介して、孔部７５に接続する燃料ガス排出装置に排出される。

【００５８】なお、上記した説明では、酸化ガス供給マニホールド６０と酸化ガス排出マニホールド６２、および、燃料ガス供給マニホールド６３と燃料ガス排出マニホールド６５では、それぞれ、内部を通過するガスの流れる方向が逆向きとなっているが、供給側のマニホールドと排出側のマニホールドとで、同じ方向にガスが通過する構成としても良い。すなわち、エンドプレート８０側ではなくエンドプレート８５側に、酸化ガス排出装置および燃料ガス排出装置を接続し、スタック構造１５において、ガスが供給される端部とは反対側の端部よりガスを排出することとしても良い。

【００５９】以上のように構成された本実施例のセパレータ３０を備える燃料電池によれば、酸化ガス配流マニホールドおよび燃料ガス配流マニホールドを備えており、各単セル内ガス流路を通過するガスが、単セル内ガス流路を通過する途中で、これらガス配流マニホールドを一旦経由する。これによって、燃料電池を構成する単セルの一部において、既述した凝縮水や、セパレータ表面に形成された凹凸形状の精度に起因して、単セル内ガス流路を通過するガスの流量にばらつきが生じていた場合にも、配流マニホールドを経由することで、単セル内ガス流路を通過するガス流量が均一化され、配流マニホールドを経由したガス流量のばらつきが軽減される。例えば、燃料電池を構成する単セル２０のいずれかにおいて、凝縮水のために、凹部９０によって形成される単セル内酸化ガス流路を通過する酸化ガスの流量が少なくなった場合にも、各単セル内を通過する酸化ガスが一旦集合する酸化ガス配流マニホールドを経由することによって、近隣に配置された単セルから酸化ガスが補われ、凹部９１によって形成される単セル内酸化ガス流路では酸化ガスの流量が充分となり、特定の単セルにおいて供給される酸化ガス量が極端に低下してしまうことがない。逆に、燃料電池を構成する単セル２０のいずれかにおいて、凝縮水のために、凹部９１によって形成される単セル内酸化ガス流路を通過する酸化ガスの流量が少なくなった場合にも、凹部９０によって形成される上流側の単セル内酸化ガス流路では、酸化ガス配流マニホールドと連通することによって、充分量の酸化ガスが通過することができる。したがって、各単セル内ガス流路を通過するガス流量のばらつきに起因して燃料電池の性能が低下してしまうのを抑えることができる。

【００６０】図6は、本実施例のセパレータ３０を用いて構成した燃料電池と、比較例として図8に示したセパ

レータ130を用いて構成した燃料電池とで、電流−電圧特性を比較した説明図である。セパレータ130は、本実施例のセパレータ30とほぼ同様の形状を有しているが、孔部41および孔部51に対応する構造は有しておらず、例えばセパレータ130の一方の面側では、連続して形成され3カ所の屈曲部を有する単一の凹部190が形成されている(図8参照)。従って、セパレータ130を用いて構成した燃料電池は、酸化ガス配流マニホールドおよび燃料ガス配流マニホールドを有しておらず、各単セル内ガス流路を通過するガスは、上記実施例のように途中で一旦互いに行き来可能となることがない。なお、図8に示したセパレータ130において、セパレータ30と共通する構成には、セパレータ30に付した部材番号に100を加えた部材番号を付し、詳しい説明は省略する。また、セパレータ130の凹部190においても、図4に示したセパレータ30の凹部90に設けられた凸部94と同様の凸部が設けられており、セパレータ130は、セパレータ30の場合と同等の面積において、隣接するガス拡散電極と接して導電性を確保するものとする。

【0061】図6に示すように、セパレータ30によって構成され、酸化ガス配流マニホールドおよび燃料ガス配流マニホールドを有する燃料電池は、セパレータ130によって構成され、酸化ガス配流マニホールドおよび燃料ガス配流マニホールドを有しない燃料電池に比べて、出力電流が大きくなっても、より高い出力電圧を維持することができた。すなわち、配流マニホールドを設け、それぞれの単セル内ガス流路を通過するガスの流量を均一化することによって、燃料電池の性能の低下を抑えることができた。

【0062】また、セパレータ30を用いて構成した燃料電池は、この燃料電池を構成する単セル中の一部の単セルにおいて、単セル内ガス流路を通過するガス流速が低下する事態が生じた場合に、この単セル内ガス流路におけるガス流速を均一化するという効果だけでなく、燃料電池全体で、各単セル内ガス流路を通過するガスの流速の勾配を均一化するという効果を奏する。図7は、セパレータ30を用いて構成した燃料電池と、セパレータ130を用いて構成した燃料電池とのそれぞれにおいて、内部の各単セル内ガス流路を通過するガスの流速の分布状態を調べた結果を表わす説明図である。ここで、それぞれの燃料電池は積層された100組の単セルからなり、それぞれの単セル内を通過するガスの流速としては、ガス供給マニホールドから各単セル内ガス流路にガスが流れ込むときの流速を測定した値を用いた。

【0063】この図7では、燃料電池の上流側(ガス供給装置およびガス排出装置が接続された側)端部に配設された単セル内ガス流路内を通過するガスの流速を100とし、残りの単セル内ガス流路におけるガス流速をこれに対する相対値として順次表わした。既述した実施例のように、ガス供給装置とガス排出装置とを、燃料電池の同じ側の端部に接続する場合には、この接続された端部である上流側が最もガス流速が早くなり、反対側(下流側)の端部に向けて徐々にガス流速は遅くなる。セパレータ30を用いて構成した燃料電池においても、上記上流側から下流側に向かって(図7ではセル番号1側からセル番号100側に向かって)ガス流速は遅くなるが、図7に示すように、比較例であるセパレータ130を用いて構成した燃料電池に比べて、下流側に向かってガス流速が遅くなる程度が小さい。

【0064】このように、本実施例のセパレータ30を用いた燃料電池によれば、各単セル内流路を通過するガスの流速の勾配が小さくなり、燃料電池全体で、単セル内ガス流路を通過するガスの流速が高いレベルに保たれるため、上記下流側に配設された単セルにおいても、ガスの利用率が充分に高くなる。したがって、既述した図6に示したように、セパレータ30を用いた燃料電池が高い電池性能を示すのは、このように燃料電池全体で充分なガス流速が維持されるという効果にもよっていると考えることができる。

【0065】さらに、燃料電池全体で各単セル内流路を通過するガスの流速が速くなることにより、燃料電池全体でガスの流量が充分に多く維持されるということができ、ガス流量が最も少なくなる領域でのガス流量を充分に確保するために燃料電池に供給するガスを加圧する程度を、抑えることができる。また、燃料電池全体でガスの利用率が充分に高くなることによって、燃料電池に供給するガスの流量を低減することができるという効果も得られる。燃料電池には、通常は、充分に電気化学反応を進行させるために、発電させる電力量から理論的に求められるガスの所要量を超える量のガスが供給される。上記したようにガスの利用率が高まれば、このように過剰に供給するガス量を抑えることができる。燃料電池に供給するガス量およびガスの加圧の程度を抑えられることによって、発電のために消費される燃料の量を抑えたり、燃料電池に供給するガスを加圧するために消費する電力量を抑えることができ、燃料電池を備えるシステム全体のエネルギ効率を向上させることができる。

【0066】また、上記した実施例におけるセパレータ30を用いた燃料電池において、各単セル内に設けられたそれぞれの単セル内ガス流路をガスが通過する際には、セパレータ表面に設けられた凹部の形状に従ってガスは略水平方向に流れるが、各単セル内ガス流路全体では、ガスは上方から下方へ流れる。例えば、酸化ガスは、孔部40が設けられた上方から、孔部42が設けられた下方に向かって流れる。従って、ガス流路内に生じた凝縮水も、重力に逆らうことなく、ガスの流れと共に下方に導かれるため、単セル内ガス流路からの凝縮水の排水が容易になる。ここで、流路内で生じる凝縮水とは、既述したように、電気化学反応に伴ってカソード側

で生じる既述した生成水や、燃料電池にガスを供給するのに先立って、電解質膜の乾燥を防ぐためにあらかじめ供給ガスに加えられる水蒸気などが、ガス流路内で凝縮したものである。

【0067】さらに、本実施例のセパレータ30を用いた燃料電池では、ガスマニホールドが燃料電池の側面に設けられており、各単セルに供給されるガスは、各単セル内ガス流路に対して横向きに流れ込む。従って、ガスマニホールド内に生じた凝縮水が、各単セル内ガス流路におけるガスマニホールドとの接続部付近を塞ぎ、ガスの流れを妨げてしまうのを抑えることができる。これに対し、ガスマニホールドが燃料電池の上下に設けられており、各単セル内ガス流路に対して、ガスが上方のガスマニホールドから供給される場合には、このガスマニホールド内の凝縮水が、容易に単セル内ガス流路に流れ込み、ガス流路を閉塞してしまうおそれがある。

【0068】既述した実施例のセパレータ30では、その表面を水平方向に4分割し、分割された領域を二つずつ連続させて、例えば図2に示した面側では凹部90および凹部91とし、これら凹部90，91を連通させる孔部41によって、単一の酸化ガス配流マニホールド61を形成することとした。ここで、酸化ガス（あるいは燃料ガス）配流マニホールドは複数設けることとしても良く、このような構成のセパレータの一例をセパレータ230として図9に示す。図9に示したセパレータ230は、その一方の表面が、セパレータ30と同様に水平方向に4分割されているが、この分割された領域は、それぞれ別個の4つの凹部（凹部290，291，292，293）を形成しており、セパレータ230を用いて燃料電池を構成したときには、これらの凹部は、隣接するガス拡散電極との間で単セル内酸化ガス流路を形成する。また、セパレータ230は、5つの孔部（孔部240，241，242，243，244）を備えている。セパレータ230を用いて燃料電池を構成したときには、これらの孔部は、酸化ガスが通過するガスマニホールドを形成する。

【0069】ここで、孔部240は、酸化ガス供給マニホールドを形成し、この酸化ガス供給マニホールドは、外部から供給された酸化ガスをそれぞれの単セル内ガス流路に分配する。また、孔部242は、酸化ガス排出マニホールドを形成し、この酸化ガス排出マニホールドは、それぞれの単セル内流路から排出された酸化ガスを合流させて、燃料電池の外部に導く。孔部241，243，344は、それぞれ、酸化ガス配流マニホールドを形成し、燃料電池を構成する単セル内に形成されたそれぞれの単セル内酸化ガス流路を通過する酸化ガスは、これらの酸化ガス配流マニホールドのそれぞれを一旦経由する。

【0070】上記凹部290は、孔部240と孔部243とを連通させ、凹部291は、孔部243と孔部241とを連通させ、凹部292は、孔部241と孔部244とを連通させ、凹部293は、孔部244と孔部242とを連通させる。したがって、外部から供給された酸化ガスは、まず、孔部240によって形成される酸化ガス供給マニホールドを経由して、凹部290によって形成される単セル内酸化ガス流路に導入される。この単セル内酸化ガス流路を通過した酸化ガスは、孔部243によって形成される酸化ガス配流マニホールドを経由した後、凹部291によって形成される単セル内酸化ガス流路を通過する。その後、同様の動作を繰り返し、孔部241によって形成される酸化ガス配流マニホールドを経由し、凹部292によって形成される単セル内酸化ガス流路を通過し、孔部244によって形成される酸化ガス配流マニホールドを経由した後、凹部293によって形成される単セル内酸化ガス流路を通過し、孔部242によって形成される酸化ガス排出マニホールドを介して、燃料電池の外部に排出される。

【0071】このようなセパレータ230を用いて構成した燃料電池によれば、セパレータ30を用いた上記実施例と同様に、それぞれの単セル内ガス流路に供給される酸化ガスの流量を均一化すると共に、燃料電池全体でガスの流速を充分に高く保ち、燃料電池の性能が低下してしまうのを防ぐことができる。特に、セパレータ30を用いる場合に比べて、酸化ガス配流マニホールドの数が多いため、各単セル内を通過する酸化ガスの流量を均一化する効果をさらに高めることができる。

【0072】なお、既述した実施例のセパレータ30を用いた燃料電池では、酸化ガスの流路と燃料ガスの流路との両方で、ガス配流マニホールドを設けることとしたが、どちらか一方の流路だけに設けることとしても良く、どちらか一方の流路にこのようなガス配流マニホールドを設けた場合にも、相応の効果が得られる。図9に示したセパレータ230では、燃料ガスが通過するマニホールドは一対だけ設け、酸化ガス流路側にだけガス配流マニホールドを設けることとしたが、このような場合にも、酸化ガスの流量を均一化することによる上記した効果を充分に得ることができる。もとより、燃料ガス流路側にだけ配流マニホールドを設けることとしても、燃料ガスの流量が均一化することによる上記した効果を得ることができる。どちらか一方の流路にだけガス配流マニホールドを設ける場合には、他方のガス流路においてガス配流マニホールドを形成するために孔部を設ける必要がなく、セパレータの成形がより容易になる。

【0073】既述した実施例では、セパレータの表面を水平方向に4分割したが、セパレータ表面を異なる数に分割して、ガス配流マニホールドを設けることとしても良い。このような例を以下に示す。図10は、セパレータ表面を水平方向に2分割したセパレータ330の構成を表わす平面図である。セパレータ330を用いて構成する燃料電池では、セパレータ330の表面を2分割し

て設けられた凹部３９０，３９１によって単セル内酸化ガス流路が形成される。また、このような燃料電池では、孔部３４０によって酸化ガス供給マニホールドが、孔部３４２によって酸化ガス排出マニホールドが、孔部３４３によって酸化ガス配流マニホールドが形成される。酸化ガス供給マニホールドから各単セルに分配された酸化ガスは、凹部３９０が形成する単セル内酸化ガス流路を通過して、酸化ガス配流マニホールドを一旦経由し、その後凹部３９１が形成する単セル内ガス流路を通過し、酸化ガス排出マニホールドを介して外部に排出される。

【００７４】また、図１１に、セパレータ表面を３分割したセパレータ４３０の構成を表わす平面図を示す。セパレータ４３０を用いて構成する燃料電池では、セパレータ４３０の表面を水平方向に３分割して設けられた凹部４９０，４９１，４９２によって単セル内酸化ガス流路が形成される。また、このような燃料電池では、孔部４４０によって酸化ガス供給マニホールドが、孔部４４２によって酸化ガス排出マニホールドが、孔部４４３，４４４によって酸化ガス配流マニホールドが形成される。酸化ガス供給マニホールドから各単セルに分配された酸化ガスは、凹部４９０，４９１，４９２のそれぞれが形成する単セル内酸化ガス流路を順次通過する。その際、連続する２つの単セル内酸化ガス流路同士を連通させる酸化ガス配流マニホールドを順次経由する。凹部４９２が形成する単セル内ガス流路を通過した酸化ガスは、酸化ガス排出マニホールドを介して外部に排出される。

【００７５】図１２は、セパレータ表面を６分割したセパレータ５３０の構成を表わす平面図である。セパレータ５３０の一方の表面には、セパレータ５３０の表面を水平方向に６分割したうちの３つずつの領域をそれぞれ連通させて設け、それぞれ２カ所の屈曲部を有する凹部５９０，５９１が設けられている。セパレータ５３０を用いて構成された燃料電池では、これら凹部５９０，５９１によって単セル内酸化ガス流路が形成される。また、このような燃料電池では、孔部５４０によって酸化ガス供給マニホールドが、孔部５４２によって酸化ガス排出マニホールドが、孔部５４３によって酸化ガス配流マニホールドが形成される。酸化ガス供給マニホールドから各単セルに分配された酸化ガスは、凹部５９０が形成する単セル内酸化ガス流路を通過して、酸化ガス配流マニホールドを一旦経由し、その後凹部５９１が形成する単セル内ガス流路を通過し、酸化ガス排出マニホールドを介して外部に排出される。なお、セパレータ５３０では、酸化ガス配流マニホールドを形成するための孔部は1カ所だけ設けることとしたが、複数の酸化ガス配流マニホールドを設けるためにより多くの孔部を設けることとしても良い。例えば、凹部５９０および凹部５９１が有する屈曲部に孔部を設け、このような孔部によってさらに酸化ガス配流マニホールドを形成することとしても良い。

【００７６】このように、セパレータ表面を複数の領域に分割して、単セル内ガス流路を形成するための凹部を形成し、これらの凹部と連通する孔部によってガス配流マニホールドを形成することによって、燃料電池内のガス流路を通過するガスの流量を均一化して、既述した効果を得ることができる。なお、以上の説明では、図１０～図１２に示した一方の面側、すなわち酸化ガス流路についてだけ説明したが、もう一方の面側に設けられた燃料ガス流路についても、同様の構成とすることで、ガス流路を通過するガスの流量を均一化し、燃料電池の性能を向上させることができる。ここで、セパレータ表面に形成する凹部の形状を細かくし、このような凹部によって形成されるガス流路の断面積を小さくするほど、単セル内ガス流路の所定の位置を通過するガス流量が増え、ガスの拡散性が向上してガス利用率が高まる。また、単セル内ガス流路を通過するガス流量が増えてガス流速が速くなるほど、凝縮水が吹き飛ばされ易くなり、単セル内ガス流路に凝縮水が滞留しにくくなるため、単セル内ガス流路における排水性が向上する。しかしながら、このように流路断面積を小さくすると、単セル内ガス流路をガスが通過する際の圧損も上昇してしまう。ガスが通過する際の圧損の上昇は、燃料電池に供給するガスを加圧するために要するエネルギを増加させ、燃料電池を備えるシステム全体のエネルギ効率の低下につながるおそれがある。したがって、凹部の形状の細かさは、細かくすることによってガス利用率が向上する効果や、これによって増加する圧損の影響、および、セパレータを形成する際に要求される加工精度などを考慮して適宜決定すればよい。

【００７７】なお、単セル内ガス流路を形成するためにセパレータ表面に形成した凹部には、セパレータ３０の説明で図4に示したように、流路を通過するガスを拡散させると共に、セパレータとガス拡散電極との間で導電性を確保する複数の凸部が設けられている。ここで、セパレータ表面に設けられた凹部の形状が充分に細かく、ガスの拡散性および、ガス拡散電極との間の導電性が充分に確保されるならば、凹部内に凸部９４に対応するこのような凸構造を設ける必要はない。

【００７８】既述した実施例では、セパレータ表面に設けられた所定の凹部によって形成される単セル内ガス流路を通過するガスは、そのすべてが一旦、ガス配流マニホールドを経由し、その後再び各単セルに流入する構成としたが、単セル内ガス流路を通過するガスの一部は、ガス配流マニホールドを経由しない構成としても良い。このような構成の一例として、セパレータ６３０の構成（酸化ガス流路を形成する面側の構成）を図１３に示す。セパレータ６３０は、その表面を水平方向に4分割してこれらを順次連通させた凹部６９０と、孔部６４

０，６４１，６４２を備えている。セパレータ６３０を用いて構成した燃料電池では、孔部６４０によって形成される酸化ガス供給マニホールドから各単セルに供給される酸化ガスは、凹部６９０によって形成される単セル内酸化ガス流路を通過した後、孔部６４２によって形成される酸化ガス排出マニホールドに排出されて燃料電池外に導かれる。

【００７９】ここで、単セル内酸化ガス流路を形成する凹部６９０は、セパレータ６３０上でその形状が屈曲する領域で、酸化ガス配流マニホールドを形成する孔部６４１と連通している。既述した実施例のセパレータ３０では、凹部９０と９１とは孔部４１を介して連通しているものの、凹部の構造としては孔部４１によって分断されている。セパレータ６３０が備える凹部６９０は、このように孔部６４１によって分断されているわけではなく、孔部６４０から孔部６４２までを連続して形成された凹部構造によって連通している。すなわち、孔部６４１は、凹部６９０が屈曲する端部（屈曲の外側）において、この凹部６９０と連通してセパレータ６３０の一辺に沿って形成されているが、孔部６４１に隣接する領域（屈曲の内側）は、孔部６９０に分断されることなく凹部が連続して形成されている。したがって、単セル内酸化ガス流路を通過する酸化ガスの一部は、途中で一旦、孔部６４１によって形成される酸化ガス配流マニホールドを経由するが、残りの酸化ガスは、酸化ガス配流マニホールドを経由することなく、凹部６９０が形成する単セル内酸化ガス流路を通過し、酸化ガス排出マニホールドに排出される。なお、図１３では、セパレータ６３０の一方の面側（単セル内酸化ガス流路を形成する側）の様子のみを示したが、他方の面側（単セル内燃料ガス流路を形成する側）も同様に形成されている。すなわち、燃料ガス供給マニホールドから各単セルに供給された燃料ガスは、凹部６９０と同様の凹部が形成する単セル内燃料ガス流路を導かれ、その一部は孔部６４１と同様の孔部が形成する燃料ガス配流マニホールドを経由すると共に、残りの燃料ガスは、燃料ガス配流マニホールドを経由することなく、上記凹部が形成する単セル内燃料ガス流路によって、燃料ガス排出マニホールドまで導かれる。

【００８０】このような構成のセパレータ６３０によれば、凹部（単セル内ガス流路）が屈曲する領域で、単セル内ガス流路を通過するガスの一部を、配流マニホールドを経由させることなく通過させることによって、このような屈曲部におけるガスの圧損を抑え、ガスの流れの偏りを抑えることができる。既述したように、セパレータ上に形成される単セル内ガス流路の流路断面積を小さくする構成は、流路内を通過するガス流量および流速を増やす上で有用である。しかしながら、流路断面積を小さくするために、既述した実施例のように単セル内ガス流路に屈曲部（ガスの流れの方向が変わる部位）を設ける場合には、このような屈曲部では、ガスの圧損が大きくなると共に、ガスの流れが乱れて流れに偏りを生じてしまう。屈曲部における圧損を軽減するには、屈曲部において流路幅を広げればよいが、既述した実施例のように、孔部によって凹部を分断する構成では、屈曲部における流路幅を広げるためには、孔部を大きくする必要がある。このような構成は、セパレータ全体に対して孔部の面積を大きくすることとなり、電気化学反応に利用可能な面積の割合が低下してしまい、採用しがたい。上記したセパレータ６３０のように、屈曲部の内側で凹部が連続する構成とすれば、孔部の面積を大きくすることなく屈曲部における流路幅を充分に確保することができ、屈曲部で流路が絞り込まれて圧損が増大するのを抑えることができる。

【００８１】図１４は、単セル内ガス流路の屈曲部において、ガス配流マニホールドを経由することなくガスが通過可能となる連通構造を設けたセパレータ６３０と、上記屈曲部で孔部によって凹部を分断したセパレータ３０とのそれぞれを用いた燃料電池で、ガスの流れる様子をシミュレーションした結果を表わす説明図である。図１４（Ａ）はセパレータ６３０を用いた結果を表わし、図１４（Ｂ）はセパレータ３０を用いた結果を表わしており、いずれも、ガス配流マニホールド内における圧力分布を、所定のセパレータの面上で表わしたものである。図１４（Ｂ）に示すように、孔部によって分断された凹部を備えるセパレータを用いる場合には、孔部が形成するガス配流マニホールド内では、非常に高い圧力が生じ、これによって単セル内ガス流路をガスが通過する際の圧損が大きくなる。これに対し、図１４（Ａ）に示すように、配流マニホールドを経由することなくガスが通過可能な連通構造を有する凹部を備えるセパレータを用いる場合には、ガス配流マニホールド内で生じる圧力が軽減され、単セル内ガス流路をガスが通過する際の圧損が抑えられる。

【００８２】なお、図１４では、ガス配流マニホールド内における圧力分布のみを示したが、ガス配流マニホールドに隣接して上記連通構造を設けることによって、ガス配流マニホールドに接続する単セル内ガス流路では、圧損が抑えられる他に、ガスの流れの偏りが生じ難いという効果が得られる。図１４（Ｂ）に示すように、ガス配流マニホールド内の所定の部位で特に高い圧力を生じつつ、配流マニホールド内を通過する際のガスの圧損が大きいと、ガス配流マニホールドの下流側では、ガスの流速が著しく低下する領域が生じるなど、ガスの流れに偏りが生じてしまう。このように単セル内ガス流路でガスの流れが不均一になると、電気化学反応が進行する効率が場所によってばらつくことになってしまう。セパレータ６３０を用いる場合のように、ガス配流マニホールドに隣接して上記連通構造を設けると、ガスの流れに偏りが生じるのを抑え、セパレータ全体の面上で、電気化

学反応の効率を充分に確保することができる。
【0083】また、セパレータ630のようにガス配流マニホールドに隣接して上記連通構造を設ける構成は、燃料電池をより小型化する際にも有効である。すなわち、電池性能を低下させることなく燃料電池を小型化する構成として、ガスマニホールドを形成するための孔部をより小さくする構成が考えられるが、ガス配流マニホールドに隣接して上記連通構造を設けるならば、このように孔部を小さくしても、ガスが通過する際の圧損が大きくなりすぎたりガスの流れが悪くなるという不都合が生じるのを抑えることができる。このような場合には、燃料電池を小型化しつつ、単セル内ガス流路を通過するガスの一部はガス配流マニホールドを経由するため、ガス流量を均一化する効果を得ることができると共に、残りのガスはガス配流マニホールドを経由しないことによって、充分なガスの流れを確保することができる。
【0084】既述した実施例のセパレータでは、セパレータ上に設けた凹部が形成する単セル内ガス流路は、この流路内を通過するガスの流れの方向が変更される屈曲部において、ガス配流マニホールドと連通している。ここでは、セパレータに設けられ、燃料電池内でガス配流マニホールドを形成する孔部は、セパレータの周辺部において、所定の辺に沿って形成されている。このようなセパレータにおいて、セパレータの外縁と上記孔部との距離が、孔部の端部において大きくなる構成とすることも望ましい。このような構成を図15を用いて説明する。
【0085】図15(A)は、セパレータの外縁と上記孔部との距離が、孔部の端部において大きくなる構成を表わし、図15(B)は、セパレータの外縁と上記孔部との距離が一定である構成を表わしている。なお、図15は、セパレータの構造のうち、ガス配流マニホールドを形成する孔部の一端の近傍のみを表わしているが、図15(B)に示したセパレータは、既述した実施例のセパレータ30と同一であり、図15(A)に示したセパレータ30Aもまた、図示しない他の部位は、セパレータ30と同様の構成を有しており、共通する部材にはセパレータ30と同じ番号を付して説明を省略した。セパレータ30Aは、セパレータ30における孔部41と同様に、酸化ガス配流マニホールドを形成する孔部41Aを備えている。孔部41Aの外周は、孔部41Aの端部において、セパレータ30Aの外縁に近い側のみがセパレータ30Aの内側に緩やかに傾斜しており、これによって孔部41Aの端部は次第に細くなるように形成されている。
【0086】このように構成されたセパレータ30Aによれば、より耐久性に優れた燃料電池を構成することができる。既述したようにセパレータに設けた孔部によってガス配流マニホールドを形成する場合には、単セル内ガス流路を通過するガスは、ガス配流マニホールドが設けられた単セル内ガス流路の屈曲部において流れの方向を変えるため(図15(B)中の実線矢印参照)、燃料電池を構成する各セパレータでは、ガス配流マニホールドを形成する孔部において、セパレータの外側方向に向かう力が働く(図15(B)中の破線矢印参照)。このような外向きの応力は、各セパレータでは、ガス配流マニホールドを形成する孔部の端部近傍のセパレータ辺縁部において特に集中して働く。このように力が集中して働く位置を、図15(B)のセパレータ30中に図示する。孔部41は、セパレータ30の外縁にできる限り近づけて設けることによって、燃料電池の大型化を抑えるものであるが、このように孔部41とセパレータ外縁との距離を小さくすると、図15(B)に示したように細い部材に応力が集中することになり、燃料電池の強度と耐久性を充分に確保する上で問題となる。図15(A)に示したセパレータ30Aのように、孔部41Aを、その端部においてセパレータの外縁との距離が大きくなるように形成すれば、上記した応力に対する充分な強度を実現することができ、燃料電池の耐久性を充分に確保することができる。また、上記したように孔部41Aの形状を、その端部においてセパレータの外縁との距離が大きくなるようにする構成によれば、孔部41A全体をセパレータ外縁からより遠くに形成することなく所望の強度を達成するため、セパレータの強度を確保するために、セパレータ全体、ひいては燃料電池全体が大型化してしまうことがない。
【0087】さらに、孔部41Aの形状を、その端部においてセパレータの外縁との距離が大きくなるように形成する際に、図15(A)に示したように、孔部41の外周のうち、セパレータ30Aの外縁に近い側のみが、孔部41の端部に向かうにつれてセパレータ30Aの内側に緩やかに傾斜する形状とすれば、単セル内ガス流路を通過するガスは、この緩やかに傾斜する形状に導かれてよりスムーズに流れることができる。図15(B)のように、孔部41の端部に角部が形成されていると、単セル内ガス流路の屈曲部を通過するガスは、この角部において乱流を生じ、これによってガスの圧損がさらに大きくなってしまう。図15(A)のように、ガスの流れる方向に沿って流路を形成することで、このような圧損を抑えてガスの流れをスムーズにすることができる。なお、図15では、酸化ガスの流路側を表わしたが、燃料ガスの流路側においても、同様の形状の孔部によってガス配流マニホールドを形成することで、上記した効果を得ることができる。また、図15では、ガス配流マニホールドを形成する孔部の端部のうち、一方のみを表わしたが、両方の端部を上記した形状とすることによって、セパレータの強度を確保すると共にガスの流れをスムーズにするという上記した効果を、さらに大きくすることができる。
【0088】また、既述した実施例では、ガス配流マニ

ホールドを形成する孔部は、単セル内ガス流路を形成する凹部の屈曲部、すなわち、セパレータの外周部付近に設けることとしたが、セパレータの異なる領域に設けた孔部によってガス配流マニホールドを形成しても、ガス流路を通過するガスの流速を均一化する効果を得ることができる。このような構成の一例を、セパレータ７３０およびセパレータ８３０として、それぞれ図１６および図１７に示す。

【００８９】図１６は、セパレータ７３０の構成（酸化ガス流路を形成する面側の構成）を表わす平面図である。セパレータ７３０の表面は、水平方向に４分割されており、それぞれの分割された領域に、凹部７９０，７９１，７９２，７９３が設けられている。セパレータ７３０を用いて構成した燃料電池では、セパレータ７３０の表面に設けられた凹部７９０，７９１，７９２，７９３が、この順に連通されて単セル内酸化ガス流路を形成し、孔部７４０によって酸化ガス供給マニホールドが、孔部７４２によって酸化ガス排出マニホールドが、孔部７４３，７４４，７４５によって酸化ガス配流マニホールドが形成される。

【００９０】ここで、孔部７４３は、凹部７９０および７９１を連通させ、孔部７４４は、凹部７９１および７９２を連通させ、孔部７４５は、凹部７９２および７９３を連通させているが、これらの孔部は、既述した実施例においてガス配流マニホールドを形成する孔部とは異なり、セパレータのより中心部よりに設けられている。すなわち、セパレータ表面に設けられた凹部から、セパレータ外周部に向かって張り出した屈曲部に設けるのではなく、隣接し合う凹部の端部側面同士を連通するように設けられている（図１６参照）。

【００９１】図１７は、セパレータ８３０の構成（酸化ガス流路を形成する面側の構成）を表わす平面図である。セパレータ８３０の表面は、水平方向に３分割されており、その一段目と２段目の真ん中付近までが連続して凹部８９０を形成しており、２段目の真ん中付近から３段目までが連続して凹部８９１を形成している。凹部８９０と凹部８９１の接続部分、すなわちセパレータ８３０の中心部付近には、これらの凹部を連通させる孔部８４３が設けられている（図１７参照）。セパレータ８３０を用いて構成した燃料電池では、セパレータ８３０の表面に設けられた凹部８９０，８９１が、この順に連通されて単セル内酸化ガス流路を形成し、孔部８４０によって酸化ガス供給マニホールドが、孔部８４２によって酸化ガス排出マニホールドが、孔部８４３によって酸化ガス配流マニホールドが形成される。

【００９２】なお、図１６および図１７に示したセパレータ７３０および８３０では、酸化ガスの流路側にのみこのようなガス配流マニホールドを設けることとしたが、燃料ガスの流路側にも同様のガス配流マニホールドを設けることとしても良い。

【００９３】このように、ガス配流マニホールドを形成する孔部は、セパレータ上のどの領域に設けることとしても良く、孔部によって形成されるガス配流マニホールドが、セパレータ表面に設けられた凹部によって形成されるそれぞれの単セル内ガス流路と連通しており、各単セル内を通過するガスが、このガス配流マニホールドを一旦経由することが可能であれば、燃料電池内のガス流路を通過するガスの流量を均一化させる効果を得ることができる。したがって、凹部を設けるためのセパレータ上の分割数や配流マニホールドの数に加え、配流マニホールドを形成するための孔部の位置なども、燃料電池を備えるシステム全体のエネルギ効率や、燃料電池を設置すべきスペース上の制約などを適宜考慮しつつ、自由に設計することができる。

【００９４】以上本発明の実施例について説明したが、本発明はこうした実施例に何等限定されるものではなく、本発明の要旨を逸脱しない範囲内において種々なる様態で実施し得ることは勿論である。

【図面の簡単な説明】

【図１】第１実施例の燃料電池を構成するスタック構造１５の基本単位である単セル２０の構成を表わす分解斜視図である。

【図２】セパレータ３０の構成を表わす平面図である。

【図３】スタック構造１５の外観を表わす斜視図である。

【図４】凹部９０に設けられた凸部９４の様子を表わす説明図である。

【図５】スタック構造１５内での酸化ガスの流れを立体的に表わす説明図である。

【図６】セパレータ３０とセパレータ１３０のそれぞれを用いて構成した燃料電池における電流−電圧特性を示す説明図である。

【図７】セパレータ３０とセパレータ１３０のそれぞれを用いて構成した燃料電池において、燃料電池を構成する各単セル内の流速相対値のようすを表わす説明図である。

【図８】比較例として用いたセパレータ１３０の構成を表わす平面図である。

【図９】セパレータ２３０の構成を表わす平面図である。

【図１０】セパレータ３３０の構成を表わす平面図である。

【図１１】セパレータ４３０の構成を表わす平面図である。

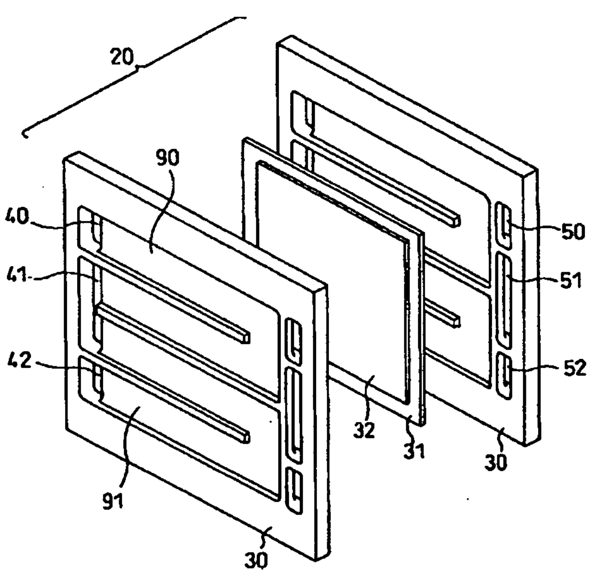
【図１２】セパレータ５３０の構成を表わす平面図である。

【図１３】セパレータ６３０の構成を表わす平面図である。

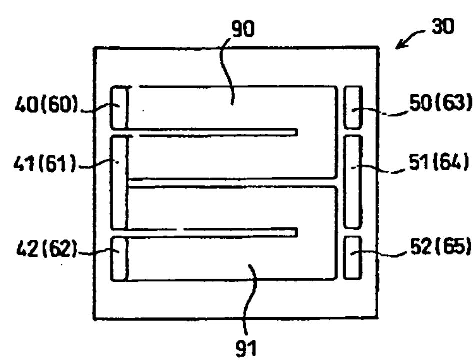
【図１４】ガス配流マニホールドにおけるガスの流れの様子をシミュレーションした結果を示す説明図である。

【図15】ガス配流マニホールドを形成する孔部の一端の構成を表わす説明図である。
【図16】セパレータ730の構成を表わす平面図である。
【図17】セパレータ830の構成を表わす平面図である。
【図18】従来知られるセパレータの一例であるセパレータ930の構成を表わす平面図である。
【符号の説明】
15…スタック構造
20…単セル
30…セパレータ
31…電解質膜
32…アノード
33…カソード
36，37…集電板
36A，37A…出力端子
38，39…絶縁板
40～42…孔部
50～52…孔部
60…酸化ガス供給マニホールド
61…酸化ガス配流マニホールド
62…酸化ガス排出マニホールド
63…燃料ガス供給マニホールド
64…燃料ガス配流マニホールド
65…燃料ガス排出マニホールド
70，72，73，75…孔部
80，85…エンドプレート
90，91，92，93…凹部
94…凸部
130…セパレータ
190…凹部
230…セパレータ
240，241，242，243，244…孔部
290，291，292，293…凹部
330…セパレータ
340，342，343…孔部
390，391…凹部
430…セパレータ
440，442，443，444…孔部
490，491，492…凹部
530…セパレータ
540，542，543…孔部
590，591…凹部
630…セパレータ
640～642…孔部
690…凹部
730…セパレータ
740，742，743～745…孔部
790～793…凹部
830…セパレータ
840，842，843…孔部
890，891…凹部
930…セパレータ
940，942，950，952…孔部
990…凹部

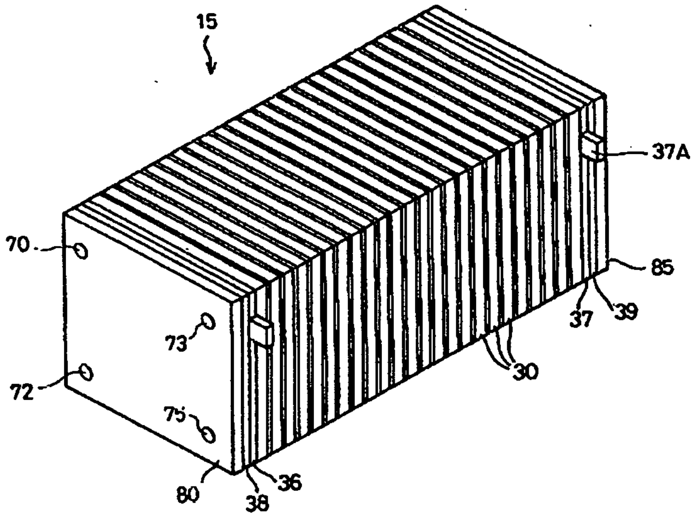
【図1】



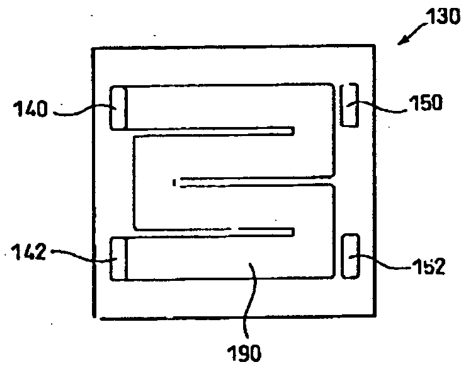
【図2】



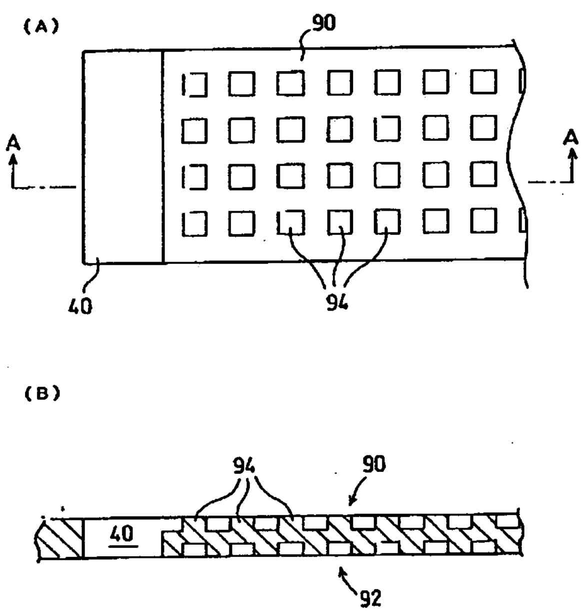
【図3】


15
37A
70
73
72
75
80
38
36
30
37
39
85

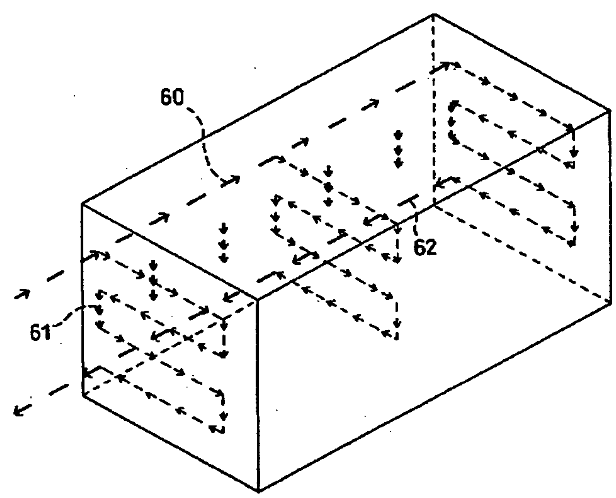
【図8】


130
140
150
142
152
190

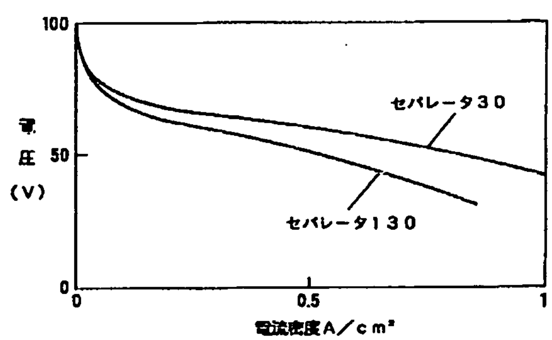
【図4】


(A)
90
A
A
40
94
(B)
94
90
40
92

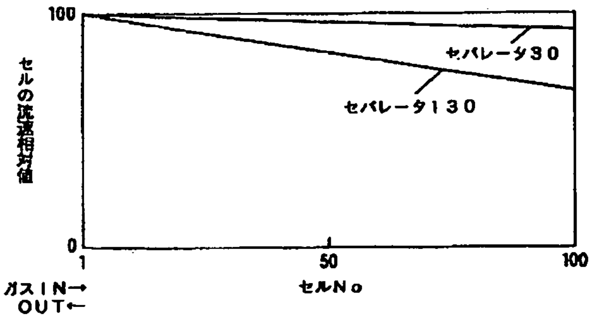
【図5】


60
62
61

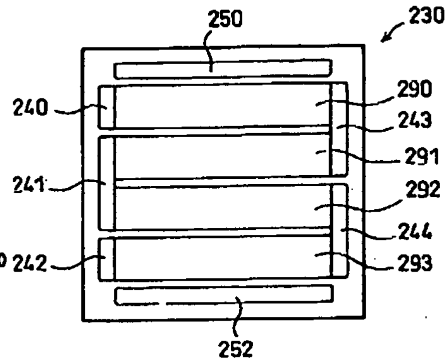
【図6】


100
50
0
電
圧
(V)
セパレータ30
セパレータ130
0
0.5
1
電流密度A／cm²

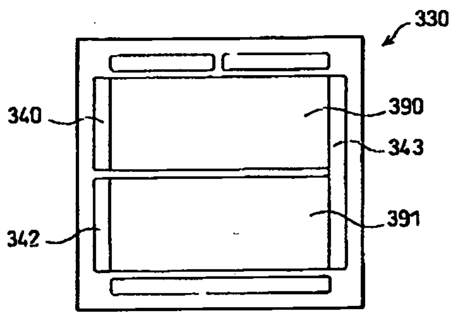
【図7】



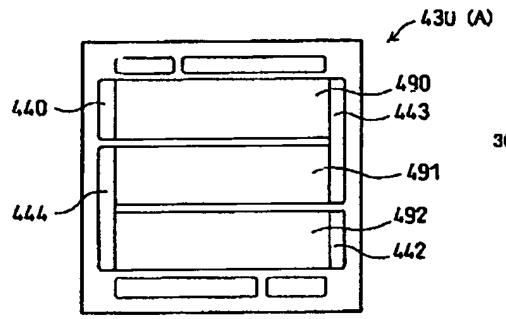
【図9】



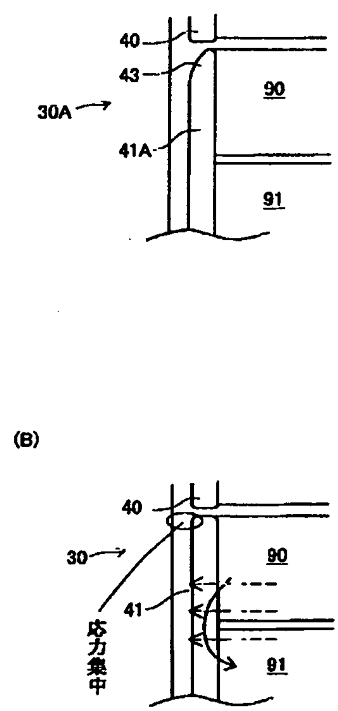
【図10】



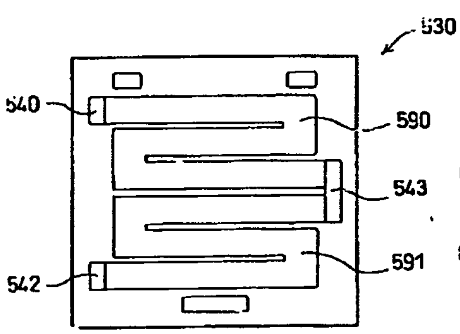
【図11】



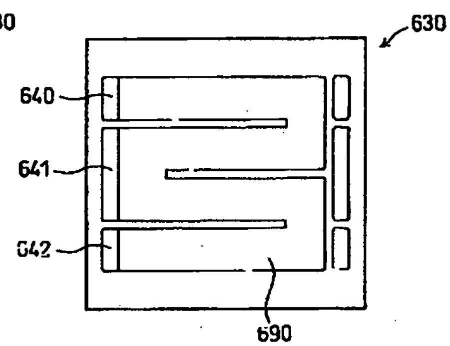
【図15】



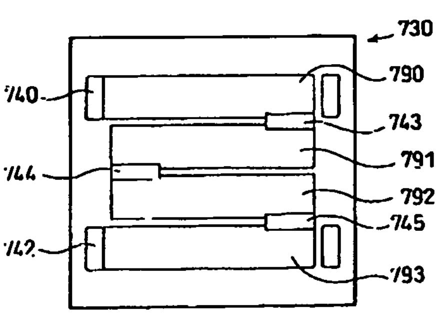
【図12】



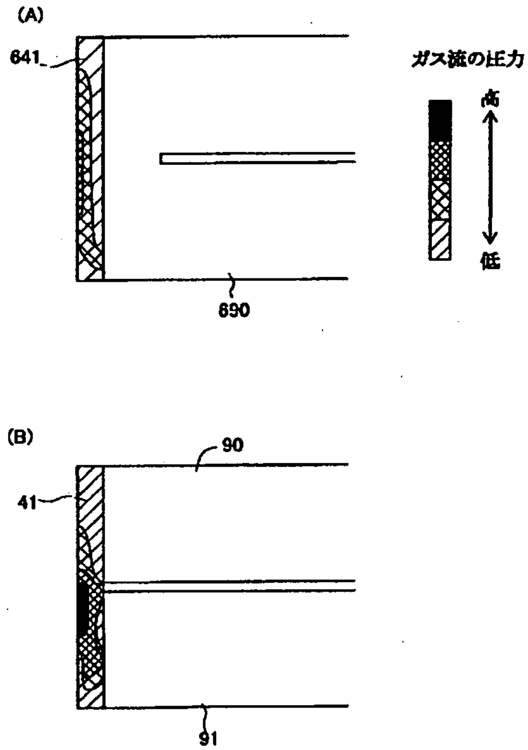
【図13】



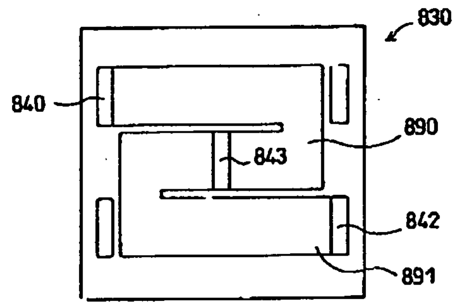
【図16】



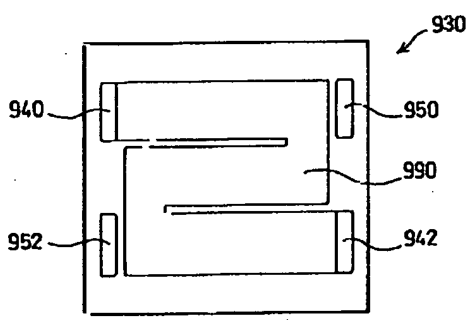
【図14】


(A)
641
690
ガス流の圧力
高
低
(B)
90
41
91

【図17】


830
840
890
843
842
891

【図18】


930
940
950
990
952
942

CLAIMS

[Claim(s)]
[Claim 1]A fuel cell which acquires electromotive force according to electrochemical reaction which carried out the plural laminates of the single cell, and used gas in each single cell, comprising:
A gas passageway in a single cell for being provided respectively succeeding inside of said each single cell, passing said gas, and spreading this gas in said each single cell.
A gas supply manifold which distributes said gas which flows from the outside of said fuel cell, and is supplied to a gas passageway in said each single cell.
A gas exhaust manifold which collects said gas discharged from a gas passageway in said each single cell, and is made to flow into the exterior of said fuel cell.
A ** style manifold which penetrates said each gas passageway in a single cell to a laminating direction of said single cell, respectively, and enables traffic of said gas between said each gas passageway in a single cell.

[Claim 2]The fuel cell according to claim 1 provided with two or more said ** style manifolds.
[Claim 3]The fuel cell according to claim 1 or 2 which is fuel gas with which said gas contains hydrogen.
[Claim 4]The fuel cell according to claim 1 or 2 which is oxidizing gas with which said gas contains oxygen.
[Claim 5]The fuel cell comprising according to claim 1:
The 1st field where a gas passageway in said single cell has in a bent part in which a channel is crooked so that a flow direction of said gas which passes an inside may be changed, and said ** style manifold penetrates said bent part.
The 2nd field that enables passage of said a part of gas which passes an inside of said bent part via said ** style manifold.

[Claim 6]The fuel cell according to claim 5 with which said bent part has accomplished U type.
[Claim 7]Are the fuel cell according to claim 1, and a gas passageway in said single cell, A fuel cell with which has a bent part in which a channel is crooked so that a flow direction of said gas which passes the inside may be changed, a periphery of said bent part is formed so that it may curve smoothly, and said ** style manifold penetrates a gas passageway in said single cell in a peripheral part of said bent part.
[Claim 8]Are the fuel cell according to claim 1, and a gas passageway in said single cell, Have a bent part in which a channel is crooked near the rim of said fuel cell so that a flow direction of said gas which passes the inside may be changed, and said ** style manifold, Are provided near the rim of said fuel cell, and in a peripheral part of said bent part, penetrate and a gas passageway in said single cell sectional shape of said ** style manifold, An internal surface corresponding to an end of said sectional shape which accomplishes longwise shape where a rim of said fuel cell was met, and accomplishes longwise shape among internal surfaces by the side of said fuel cell rim in said ** style manifold, A fuel cell characterized by thickness from a rim of said fuel cell being thick compared with an internal surface

corresponding to a center section of said sectional shape.
[Claim 9]A gas separator for fuel cells characterized by comprising the following which constitutes said single cell with a member which is used for a fuel cell which laminates two or more single cells, and forms an electrolyte layer and an electrode.
Three or more holes for penetrating this gas separator for fuel cells to the thickness direction, respectively, being provided, and forming a part of gas manifold of said fuel cell, respectively.
in one field top of said gas separator for fuel cells -- up to the 2nd predetermined hole from the 1st predetermined hole among said three or more holes -- these 1st and 2nd holes -- a crevice for being provided so that said field top may be made to open for free passage via a hole of an except one by one, and forming a gas passageway in said single cell.

[Claim 10]The gas separator for fuel cells according to claim 9 characterized by comprising the following.
said crevice makes said from 1st predetermined hole to the 2nd hole open for free passage on one field of said gas separator for fuel cells -- on the way -- it being alike and having a bent part straight on this one field -- said bent part -- said 1st and 2nd holes -- the 1st field that one of the holes of an except penetrates.
The 2nd field in which the bottom of said crevice is formed continuously without being divided by said hole which penetrates this 1st field.

[Claim 11]Are the gas separator for fuel cells according to claim 9, and said crevice, While making said from 1st predetermined hole to the 2nd hole open for free passage on one field of said gas separator for fuel cells, having a bent part straight on this one field near the rim of said gas separator for fuel cells -- said 1st and 2nd holes -- one of the holes of an except. Accomplish longwise shape where it was allocated near the rim of said gas separator for fuel cells, and a rim of said gas separator for fuel cells was met, and. A wall surface located in the rim side of said gas separator for fuel cells among wall surfaces which penetrate said crevice and form this hole in a peripheral part of said bent part, A gas separator for fuel cells currently forming compared with a portion corresponding to a center section in a portion corresponding to an end of said hole which accomplishes longwise shape so that distance from a rim of said gas separator for fuel cells may become large.
[Claim 12]It is a distribution method of gas in a fuel cell which acquires electromotive force according to electrochemical reaction which carried out the plural laminates of the single cell, and used this gas in response to supply of gas, (a) said supplied gas in a process distributed to a gas passageway in a single cell formed in an inside of each of said single cell via a gas supply manifold in which it was provided by said fuel cell, and said single cell of each (b) from said fuel cell outside, Said gas distributed from said gas supply manifold, passing a gas passageway in said single cell. A process with which electrochemical reaction [each] which advances by said single cell is presented, and said gas discharged from a gas passageway in each of said single cell after the (c) aforementioned electrochemical reaction was presented, Have a process of discharging gas which gathered a gas exhaust manifold provided in said fuel cell, and this gathered out of said fuel cell, and the aforementioned (b-1) (b) process, A distribution method of gas in a fuel cell further provided with a process which makes it go via a ** style manifold formed in a laminating direction of said single cell by penetrating in an inside of said fuel cell in said at least a part of each of said single cell gas which passes a gas passageway in said single cell.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention about the distribution method of the gas in the gas separator for fuel cells, a fuel cell, and a fuel cell in detail, In the fuel cell which carries out the plural laminates of the single cell, and constitutes it, it is provided between the adjoining single cells, and form a fuel gas flow route and an oxidizing gas passage between the adjoining members, and. It is related with the distribution method of the gas in the fuel cell using the separator for fuel cells which separates fuel gas and oxidizing gas, and this separator, and this fuel cell.
[0002]
[Description of the Prior Art]The gas separator for fuel cells is a member which constitutes the fuel cell stack by which two or more single cells were laminated, and has prevented mixing the fuel gas and oxidizing gas which are supplied to each of an adjacent single cell by having sufficient gas impermeability. Such a separator for fuel cells usually has rugged structure, such as the shape of a rib, on the surface.
It also has the work which forms the channel of fuel gas and oxidizing gas (the gas separator of such composition is also called interconnector with a rib).
That is, the separator for fuel cells forms the channel (gas passageway in a single cell) of fuel gas or oxidizing gas between the adjoining member (gas diffusion layer) and the above-mentioned rugged structure, when included in a fuel cell stack.
[0003]The gas separator for fuel cells has a predetermined hole structure other than the rugged structure which usually forms the above-mentioned gas passageway. the corresponding hole with which the adjacent gas separator was equipped when a single cell provided with such a gas separator was laminated and a fuel cell stack was constituted -- structures lap -- these holes -- the gas manifold which pierces through the inside of a fuel cell stack to the laminating direction is formed of structure. Such a gas manifold gathers a fuel exhaust gas or oxidation exhaust gas after distributing to each single cell, making the inside pass the fuel gas or oxidizing gas supplied from the outside of a fuel cell or presenting electrochemical reaction by each single cell, and makes these flow into the fuel cell exterior. Therefore, the gas manifold formed of the above-mentioned hole structure is open for free passage with the above-mentioned gas passageway in a single cell (the oxidizing gas passage in a single cell, or the fuel gas flow route in a single cell) formed in each laminated single cell.
Gas flows out between a gas manifold and the channel in a single cell, and ON is possible.

[0004]Drawing 18 is an explanatory view which expresses the composition of the separator 930 superficially as an example of the gas separator for fuel cells known conventionally. the separator 930 -- the circumference near [the] -- four holes -- it has the pore 940,942,950,952 as a structure. When these pores laminate two or more single cells which consist of a member containing the separator 930 and constitute a fuel cell, The corresponding pores with which the adjacent separator 930 is provided lap, and inside a fuel cell, Respectively An oxidizing gas supply manifold (the oxidizing gas supplied from

the outside is distributed to each oxidizing gas passage in a single cell), An oxidizing gas exhaust manifold (the oxidation exhaust gas discharged from each oxidizing gas passage in a single cell is gathered, and it leads out of a fuel cell), A fuel gas supply manifold (the fuel gas supplied from the outside is distributed to each fuel gas flow route in a single cell) and a fuel gas exhaust manifold (the fuel exhaust gas discharged from each fuel gas flow route in a single cell is gathered, and it leads out of a fuel cell) are formed.

[0005]The crevice 990 which makes the pore 940 and the pore 942 open for free passage is established in one field of the separator 930.

The crevice (not shown) which makes the pore 950 and the pore 952 open for free passage is established in the field of another side of the separator 930.

Both these crevices have the grooved structure of having two flections on the way. When the member containing the separator 930 is laminated and a fuel cell is constituted, these crevices form the gas passageway in a single cell between the members which adjoin the separator 930. That is, the crevice 990 which makes the pore 940 and the pore 942 open for free passage forms the oxidizing gas passage in a single cell, and the crevice which makes the pore 950 and the pore 952 open for free passage forms the fuel gas flow route in a single cell. The oxidizing gas supplied to the fuel cell passes through the inside of the oxidizing gas supply manifold formed of the pore 940, After being distributed to the oxidizing gas passage in a single cell formed in each single cell and presenting electrochemical reaction, it joins by the oxidizing gas exhaust manifold formed of the pore 942, and is discharged by the fuel cell exterior. Similarly the fuel gas supplied to the fuel cell passes through the inside of the fuel gas supply manifold formed of the pore 950, After being distributed to the fuel gas flow route in a single cell formed in each single cell and presenting electrochemical reaction, it joins by the fuel gas exhaust manifold formed of the pore 952, and is discharged by the fuel cell exterior.

[0006]Especially in the separator 930 shown in such drawing 18. Since the crevice provided on each field of the separator 930 serves as shape in which only half one round trip is crooked, compared with the case where shape straight in this way is not used, the passage cross section of the gas passageway in a single cell becomes small, and the rate of flow of the gas which passes through the arbitrary places of a channel can be made quicker. Therefore, the gas which passes through the inside of the gas passageway in a single cell is better stirred in a channel, and will be in the state where it is spread. By being in such a state, the electrode active material (hydrogen or oxygen) in gas (fuel gas or oxidizing gas) contacts easily the catalyst bed provided on the electrode, and an electrode active material becomes is easy to be used by electrochemical reaction, and the capacity factor of gas improves.

[0007]As shape of the crevice established in the surface of the gas separator for fuel cells other than composition of having been shown in drawing 18, As described above, on the same flat surface, establish respectively two or more crevices of the shape where only half one round trip was crooked in parallel, and two or more crevices on these same fields are received, The composition which performs the feeding and discarding of gas is proposed via the gas introduction hole and gas discharge hole of a couple which form a gas supply manifold and a gas exhaust manifold (for example, JP,7-263003,A etc.). Since the passage cross section of the gas passageway in a single cell will become still smaller and the rate of flow of the gas which passes through the arbitrary places in a channel will become quicker by providing two or more crevices of the crooked shape on the same flat surface if it has such composition, the capacity factor of the gas in a fuel cell can be raised further.

[0008]

[Problem(s) to be Solved by the Invention]However, in the gas separator for fuel cells indicated by above-mentioned drawing 18 and gazette. The hole which the gas supplied to the gas passageway in this single cell passes in the gas passageway in a single cell with which each single cell is provided (drawing 18 the pore 940 and the pore 950), And since there was only one hole (drawing 18 the pore 942 and the pore 952) which the gas discharged from the gas passageway in a single cell passes at a time, respectively, there was a problem that there was a possibility that the ** style of gas to each single cell which constitutes a fuel cell may become uneven. For example, when the produced water etc. which are produced in connection with electrochemical reaction condense in the channel of gas, if this water of

condensation stagnates near the terminal area of a gas manifold and the gas passageway in a single cell, and in the gas passageway in a single cell, The resistance to the flow of gas will arise in the gas passageway in a single cell corresponding to the part in which this water of condensation stagnated, and the flow of gas will be barred. Thus, by the single cell in which the supply state of gas got worse, since electrochemical reaction will not fully advance, with the whole fuel cell, output voltage shows dispersion between each single cell, and there is a possibility that the performance of a fuel cell may fall.

[0009]Here, the water of condensation produced in a gas passageway is explained. The water of condensation produced all over the channel of oxidizing gas originates in the produced water produced in the cathode side in connection with electrochemical reaction. Below, the electrochemical reaction which advances by each single cell which constitutes a polymer electrolyte fuel cell is expressed.
[0010]

$H_2 \rightarrow 2H^+ + 2e^-$ -- (1)

$(1/2)\ O_2 + 2H^+ + 2e^- \rightarrow H_2O$ -- (2)

$H_2 + (1/2)\ O_2 \rightarrow H_2O$ -- (3)

[0011](1) The reaction which a formula shows the reaction [reaction / by the side of an anode] by the side of a cathode of (2) types, and is shown in (3) types as the whole cell advances. Thus, in a polymer electrolyte fuel cell, produced water arises by the cathode side with advance of a cell reaction. Although the produced produced water is evaporated in the oxidizing gas currently supplied to the cathode side and it is discharged out of a fuel cell with oxidizing gas, When the field where temperature is low is all over the time with many amounts of produced water, and the channel through which oxidizing gas flows selectively, produced water may condense in the channel of oxidizing gas, and the water of condensation may stagnate in a channel.
[0012]In the anode side, although produced water does not arise in connection with electrochemical reaction, the fuel gas supplied to the anode side usually humidifies beforehand, before supplying a fuel cell. Namely, when the reaction shown in the above-mentioned (1) formula by the anode side advances, the produced proton will be in the state where water runs short, by the anode side of a solid electrolyte in order to move toward the cathode side in the state where it hydrated with the water molecule in the inside of a solid-electrolyte membrane, but. Dryness of a solid electrolyte has prevented desiccation of the solid-electrolyte membrane by supplying the fuel gas usually beforehand humidified as described above in order to reduce the conductivity of a solid electrolyte. Therefore, the steam added to this fuel gas may condense in the channel of fuel gas. Thus, when the water of condensation produced in the channel of oxidizing gas or the channel of fuel gas stagnates and the supply state of gas gets worse in some single cells, there is a possibility that the performance of the whole fuel cell may get worse.
[0013]The problem that output voltage will vary between each single cell which constitutes a fuel cell may originate in the accuracy at the time of the above-mentioned water of condensation becoming a cause, and also fabricating the gas separator for fuel cells, and may be produced. In order to form a gas passageway, when the accuracy of shaping is insufficient in the rugged structure formed in the gas separator surface (i.e., when the depth of the formed unevenness has dispersion), The passage resistance at the time of gas passing the gas passageway in a single cell will vary for every single cell, and the gas volume supplied for every single cell will vary. Therefore, it originated in the accuracy at the time of fabricating a gas separator in the fuel cell using the gas separator known conventionally, output voltage varied between each single cell, and there was a possibility that the performance of the whole fuel cell might get worse.
[0014]The distribution method of the gas in the gas separator for fuel cells, fuel cell, and fuel cell of this invention solved such a problem, was made for the purpose of preventing battery capacity from the flow of the gas which passes through the inside of each single cell becoming uneven, and falling, and took the next composition.
[0015]

[The means for solving a technical problem, and its operation and effect] It is a fuel cell which acquires electromotive force according to the electrochemical reaction which the fuel cell of this invention carried out the plural laminates of the single cell, and used gas in each single cell, The gas passageway in a single cell for being provided respectively succeeding the inside of said each single cell, passing said gas, and spreading this gas in said each single cell, The gas supply manifold which distributes said gas which flows from the outside of said fuel cell, and is supplied to the gas passageway in said each single cell, The gas exhaust manifold which collects said gas discharged from the gas passageway in said each single cell, and is made to flow into the exterior of said fuel cell, Let it be a gist to penetrate said each gas passageway in a single cell to the laminating direction of said single cell, respectively, and to equip it with the ** style manifold which enables traffic of said gas between said each gas passageway in a single cell.

[0016]The plural laminates of the single cell are carried out, a gas supply manifold distributes the gas which flows from the outside of a fuel cell, and the fuel cell of this invention constituted as mentioned above supplies it to the gas passageway in each single cell. The gas passageway in a single cell provided in each single cell passes said supplied gas, and spreads this gas in each single cell. In each single cell, electromotive force is acquired according to the electrochemical reaction using this gas. To a fuel cell, said each gas passageway in a single cell is penetrated in the laminating direction of said single cell, respectively, The ** style manifold which enables traffic of said gas between said each gas passageway in a single cell is formed, and when said gas passes each gas passageway in a single cell, it goes via this ** style manifold. Said gas discharged from the gas passageway in said each single cell is brought together in a gas exhaust manifold, and flows into the exterior of a fuel cell.

[0017]A distribution method of gas in a fuel cell of this invention, It is a distribution method of gas in a fuel cell which acquires electromotive force according to electrochemical reaction which carried out the plural laminates of the single cell, and used this gas in response to supply of gas, (a) said supplied gas in a process distributed to a gas passageway in a single cell formed in an inside of each of said single cell via a gas supply manifold in which it was provided by said fuel cell, and said single cell of each (b) from said fuel cell outside, Said gas distributed from said gas supply manifold, passing a gas passageway in said single cell. A process with which electrochemical reaction [each] which advances by said single cell is presented, and said gas discharged from a gas passageway in each of said single cell after the (c) aforementioned electrochemical reaction was presented, Have a process of discharging gas which gathered a gas exhaust manifold provided in said fuel cell, and this gathered out of said fuel cell, and the aforementioned (b-1) (b) process, Let it be a gist to have further a process which makes it go via a ** style manifold formed in a laminating direction of said single cell by penetrating in an inside of said fuel cell in said at least a part of each of said single cell gas which passes a gas passageway in said single cell.

[0018]Since gas which passes a gas passageway in a single cell goes via a ** style manifold according to the distribution method of gas in a fuel cell of such this invention, and a fuel cell of this invention, In either of the single cells which constitute a fuel cell, when a supply state of gas gets worse, performance of the whole fuel cell can be prevented from output voltage declining and falling. Namely, in either of the single cells by stagnation of the water of condensation, etc. When passage resistance at the time of gas flowing into a gas passageway in a single cell increases, a supply state of gas gets worse and gas which passes a gas passageway in a single cell goes via a ** style manifold, By a gas passageway in a single cell of the downstream, it becomes possible to fully secure the amount of supply of gas rather than a terminal area with this ** style manifold. Therefore, even if stagnation of the water of condensation, etc. take place, a supply state of gas does not get worse in the whole single cell in which this water of condensation stagnated.

[0019]Since gas which passes a gas passageway in each single cell goes via a ** style manifold according to the distribution method of gas in a fuel cell of this invention, and a fuel cell of this invention, with the whole fuel cell. An effect that a flow (or the rate of flow) of gas which passes a gas passageway in each single cell can be equalized is done so. In a ** style manifold, since traffic of gas between each gas passageway in a single cell is possible, when a flow of gas which passes each gas

passageway in a single cell has dispersion, they are equalized. Inside a fuel cell, predetermined inclination arises in a gas mass flow which passes through inside of each single cell according to a flow direction (flow direction of gas which passes through inside of a gas exhaust manifold) of gas by which feeding and discarding are carried out from the outside. Since the above-mentioned inclination can be made small if a gas mass flow which forms a ** style manifold and passes a gas passageway in each single cell like a distribution method of gas in a fuel cell of this invention and a fuel cell of this invention is equalized, By each single cell which constitutes the whole fuel cell, a flow of gas can fully be secured and the amount of electrochemical reaction which advances by each single cell can be maintained on a high level.

[0020]A fuel cell of this invention is good also as having two or more said ** style manifolds. If it has such composition, it originates in the water of condensation etc., and influences by supply of gas being barred in a predetermined single cell are reduced, and an effect which equalizes a flow of gas which passes each gas passageway in a single cell can be heightened further.

[0021]In a fuel cell of this invention, said gas is good also as being the fuel gas containing hydrogen. If it has such composition, in a channel of fuel gas formed in a fuel cell, the above-mentioned effect can be acquired and battery capacity (stable output voltage) of a fuel cell can be maintained highly enough.

[0022]In a fuel cell of this invention, said gas is good also as being the oxidizing gas containing oxygen. If it has such composition, in a channel of oxidizing gas formed in a fuel cell, the above-mentioned effect can be acquired and battery capacity (stable output voltage) of a fuel cell can be maintained highly enough.

[0023]A gas separator for fuel cells of this invention is used for a fuel cell which laminates two or more single cells, is a gas separator for fuel cells which constitutes said single cell with a member which forms an electrolyte layer and an electrode, and comprises the following:

Three or more holes for penetrating this gas separator for fuel cells to the thickness direction, respectively, being provided, and forming a part of gas manifold of said fuel cell, respectively.

in one field top of said gas separator for fuel cells -- up to the 2nd predetermined hole from the 1st predetermined hole among said three or more holes -- these 1st and 2nd holes -- a crevice for being provided so that said field top may be made to open for free passage via a hole of an except one by one, and forming a gas passageway in said single cell.

[0024]Such a gas separator for fuel cells is used for a fuel cell which has three or more holes provided in the thickness direction by penetrating, constitutes a single cell with a member which forms an electrolyte layer and an electrode, and laminates and constitutes two or more single cells. When a fuel cell is constituted using a gas separator for fuel cells of this invention, said three or more holes form a gas manifold of said fuel cell, respectively. moreover -- up to the 2nd hole predetermined [from the 1st predetermined hole among said three or more holes] in a gas separator for fuel cells of this invention to field top of one of these -- these 1st and 2nd holes -- it has a crevice which makes said field top open for free passage via a hole of an except one by one. When a fuel cell is constituted using a gas separator for fuel cells of this invention, this crevice forms a gas passageway in a single cell between adjoining members. A gas passageway in a single cell formed of this crevice is open for free passage with a gas manifold formed of each of said three or more holes. In such a fuel cell, if gas is supplied from the exterior of a fuel cell to a gas manifold formed of the 1st predetermined hole, supplied gas will be distributed to a gas passageway in each single cell from this gas manifold. Gas discharged by passing a gas passageway in a single cell is brought together in a gas manifold formed of the 2nd predetermined hole, and can be made to flow into the fuel cell exterior at this time. thus -- the time of gas passing a gas passageway in a single cell -- this gas -- said 1st and 2nd holes -- it goes via a gas manifold formed of a hole of an except.

[0025]According to such a gas separator for fuel cells, a fuel cell of this invention and same fuel cell can be constituted, and the same effect as a fuel cell of this invention can be acquired in such a fuel cell. Therefore, by using a gas separator for fuel cells of this invention, in either of the single cells which constitute a fuel cell, when a supply state of gas gets worse, a fuel cell without a possibility that output

voltage may decline and performance of the whole fuel cell may fall can be constituted. Equalize a flow of gas which passes each gas passageway in a single cell by using a gas separator for fuel cells of this invention, and. A fuel cell maintainable on a high level can be constituted for the amount of electrochemical reaction which fully secures a flow of gas by each single cell which constitutes the whole fuel cell, and advances by each single cell.

[0026]Said crevice formed in the surface of a gas separator for fuel cells of this invention, it is not necessary to form a flat concave surface, and may have heights which project from a concave surface -- up to the 2nd predetermined hole from the 1st predetermined hole -- these 1st and 2nd holes -- what is necessary is just the structure of making a field top of a gas separator for fuel cells opening for free passage via a hole of an except one by one

[0027]In a fuel cell of this invention, a gas passageway in said single cell, Have a bent part in which a channel is crooked so that a flow direction of said gas which passes an inside may be changed, and said bent part, It is good also as having the 1st field that said ** style manifold penetrates, and the 2nd field that enables passage of said a part of gas which passes an inside of said bent part via said ** style manifold.

[0028]When gas which passes a gas passageway in a single cell passes a bent part in which a gas passageway in this single cell is crooked, in that part, in such a fuel cell, the remainder does not go via a ** style manifold via a ** style manifold. Thus, by providing the 2nd field that does not go via a ** style manifold, in a bent part which a ** style manifold penetrates, sufficient depth can be secured, a pressure loss at the time of gas passing the above-mentioned bent part can be stopped, and a flow of gas can be made more smooth.

[0029]In a gas separator for fuel cells of this invention, said crevice, While making said from 1st predetermined hole to the 2nd hole open for free passage on one field of said gas separator for fuel cells, having a bent part straight on this one field -- said bent part -- said 1st and 2nd holes -- it is good also as having the 1st field that one of the holes of an except penetrates, and the 2nd field in which the bottom of said crevice is formed continuously without being divided by said hole which penetrates this 1st field.

[0030]According to the gas separator for fuel cells constituted as mentioned above, the above-mentioned fuel cell and same fuel cell can be constituted, and the same effect as the above-mentioned fuel cell can be acquired in such a fuel cell.

[0031]In the above-mentioned fuel cell, said bent part is still better also as having accomplished U type. Although a gas passageway in a single cell can be effectively allocated in each single cell and a gas mass flow which passes through inside of a channel can be increased by forming a bent part in U type, In a bent part which accomplishes U type, an effect which reduces a pressure loss and makes a flow of gas smooth because a pressure loss becomes large and has the above-mentioned composition can be especially acquired notably especially by changing a flow direction of gas for reverse.

[0032]In a fuel cell of this invention, a gas passageway in said single cell, Have a bent part in which a channel is crooked so that a flow direction of said gas which passes the inside may be changed, and a periphery of said bent part, It is formed so that it may curve smoothly, and said ** style manifold is good also as penetrating a gas passageway in said single cell in a peripheral part of said bent part.

[0033]Since gas which passes a gas passageway in a single cell will be led to a periphery which curves smoothly in a bent part and will flow if it has such composition, an effect that a flow of gas which passes a gas passageway in a single cell becomes more smooth is acquired.

[0034]In a fuel cell of this invention, a gas passageway in said single cell, Have a bent part in which a channel is crooked near the rim of said fuel cell so that a flow direction of said gas which passes the inside may be changed, and said ** style manifold, Are provided near the rim of said fuel cell, and in a peripheral part of said bent part, penetrate and a gas passageway in said single cell sectional shape of said ** style manifold, An internal surface corresponding to an end of said sectional shape which accomplishes longwise shape where a rim of said fuel cell was met, and accomplishes longwise shape among internal surfaces by the side of said fuel cell rim in said ** style manifold, Compared with an internal surface corresponding to a center section of said sectional shape, it is good also as thickness

from a rim of said fuel cell being thick.
[0035]According to such a fuel cell, intensity and endurance of a fuel cell are fully securable. When a ** style manifold is formed near the rim of a fuel cell and sectional shape of a ** style manifold considers it as longwise shape where a rim of a fuel cell was met, It can stop that a field which can participate in electrochemical reaction within each single cell by forming a ** style manifold becomes small, and it becomes easy to secure gas-seal nature in a ** style manifold. However, in the above-mentioned bent part which a ** style manifold penetrates, since a flow direction of gas changes, strong stress will work between an internal surface of a ** style manifold, and a rim of a fuel cell. It will concentrate in a field corresponding to an end of a section of a ** style manifold formed in longwise shape, and especially this stress has a possibility that intensity of this field may affect intensity of the whole fuel cell. By considering a fuel cell as the above composition, intensity of a field which strong stress commits by gas which passes a bent part can fully be secured, and it becomes possible to fully secure intensity of the whole fuel cell by this.
[0036]A gas separator for fuel cells of this invention, As said crevice makes said from 1st predetermined hole to the 2nd hole open for free passage on one field of said gas separator for fuel cells, having a bent part straight on this one field near the rim of said gas separator for fuel cells -- said 1st and 2nd holes -- one of the holes of an except. Accomplish longwise shape where it was allocated near the rim of said gas separator for fuel cells, and a rim of said gas separator for fuel cells was met, and. A wall surface located in the rim side of said gas separator for fuel cells among wall surfaces which penetrate said crevice and form this hole in a peripheral part of said bent part, It is good also as being characterized by being formed compared with a portion corresponding to a center section in a portion corresponding to an end of said hole which accomplishes longwise shape, so that distance from a rim of said gas separator for fuel cells may become large.
[0037]According to the gas separator for fuel cells constituted as mentioned above, the above-mentioned fuel cell and same fuel cell can be constituted, and the same effect as the above-mentioned fuel cell can be acquired in such a fuel cell.
[0038]
[Embodiment of the Invention]In order to clarify further composition and an operation of this invention explained above, an embodiment of the invention is described based on an example below. The fuel cell which is the 1st example of this invention is a polymer electrolyte fuel cell, and is formed of the stack structure which carried out the plural laminates of the single cell. The top view showing the composition of the separator 30 with which the fuel cell of this example is provided with the exploded perspective view showing the composition of the single cell 20 which is a basic unit of the stack structure 15 from which drawing 1 constitutes the fuel cell of the 1st example, and drawing 2, and drawing 3 are the perspective views showing the appearance of the stack structure 15. First, based on drawing 1 thru/or drawing 3, the composition of a fuel cell is explained, next the situation of the flow of the gas in this fuel cell is explained.
[0039]As mentioned above, the fuel cell of this example is a polymer electrolyte fuel cell, and is constituted by the stack structure 15 which laminated the single cell 20 which is a basic unit. As shown in drawing 1, the single cell 20 is constituted by the electrolyte membrane 31, the anode 32, the cathode 33, and the separator 30.
[0040]Here, the electrolyte membrane 31 is an ion-exchange membrane of the proton conductivity formed with solid polymer material, for example, fluororesin, and shows good electrical conductivity according to a damp or wet condition. In this example, the Nafion film (made by Du Pont) was used. The alloy which consists of platinum as a catalyst or platinum, and other metal is applied to the surface of the electrolyte membrane 31. The carbon powder which supported the alloy which consists of platinum or platinum, and other metal as a method of applying a catalyst is produced, The suitable organic solvent was made to distribute the carbon powder which supported this catalyst, a proper quantity of electrolytic solutions (for example, Aldrich Chemical, Nafion Solution) were added and pasted, and the method of screen-stenciling on the electrolyte membrane 31 was taken. Or the composition which carries out film shaping of the paste containing the carbon powder which supported

the above-mentioned catalyst, produces a sheet, and presses this sheet on the electrolyte membrane 31 is also preferred.
[0041]Both the anode 32 and the cathode 33 are the gas diffusion electrodes formed by the carbon crossing woven with the thread which consists of carbon fiber. It may form by the carbon paper or carbon felt which consists of carbon fiber besides carbon crossing, and what is necessary is just to have sufficient gas diffusion nature and conductivity.
[0042]The separator 30 is formed by the gas unpenetrated conductive member, for example, the shaping carbon which compressed carbon and it presupposed gas un-penetrating. Drawing 2 is a top view showing signs that the separator 30 was seen from the field of one of these. The separator 30 is provided with six holes near [the] the circumference. That is, the pores 40, 41, and 42 which are three holes which adjoin along with this neighborhood are formed near the one side of the separator 30, and the pores 50, 51, and 52 which similarly adjoin are formed near the neighborhood which counters around here. The separator 30 equips the both sides with the crevice of predetermined shape. As shown in drawing 2, the crevice 90 which makes the pore 40 and the pore 41 open for free passage with the crooked shape, and the crevice 91 which makes the pore 41 and the pore 42 open for free passage with the shape similarly crooked are established in one field of the separator 30. Above-mentioned one field, the crevice 92 which opens the pore 50 and the pore 51 for free passage with the crooked shape similarly, and the crevice 93 which opens the pore 51 and the pore 52 for free passage with the shape similarly crooked are established also in the field of another side of the separator 30 (not shown).
[0043]As shown in drawing 1, when the separator 30 is laminated with the electrolyte membrane 31, the anode 32, and the cathode 33, forms the single cell 20 and constitutes the stack structure 15 further, each crevice forms a gas passageway between adjoining gas diffusion electrodes. Namely, the pores 40 and 41 and the crevices 90 and 91 which make the pores 41 and 42 open for free passage, The pores 50 and 51 and the crevices 92 and 93 which make the pores 51 and 52 open for free passage form the fuel gas flow route in a single cell between the surfaces of the adjoining anode 32 by forming the oxidizing gas passage in a single cell between the surfaces of the adjoining cathode 33.
[0044]When the single cell 20 is laminated and the stack structure 15 is assembled, the pore 40 with which each separator 30 is provided forms the oxidizing gas supply manifold 60 which penetrates stack structure 15 inside to the laminating direction. The pore 41 forms the ********** style manifold 61 which similarly penetrates stack structure 15 inside to the laminating direction. The pore 42 forms the oxidizing gas exhaust manifold 62 which similarly penetrates stack structure 15 inside to the laminating direction. The pore 50 forms the fuel gas supply manifold 63 which similarly penetrates the stack structure 15 to the laminating direction, the pore 51 forms the fuel gas distribution manifold 64, and the pore 52 forms the fuel gas exhaust manifold 65 (refer to drawing 2). It explains later that the gas within these gas passagewaies formed in the stack structure 15 flows in detail (see drawing 5 mentioned later).
[0045]When assembling the stack structure 15 provided with each member explained above, it piles up one by one in order of the separator 30, the anode 32, the electrolyte membrane 31, the cathode 33, and the separator 30. The stack structure 15 which arranges the collecting electrode plates 36 and 37, the electric insulating plates 38 and 39, and the end plates 80 and 85 one by one to the both ends, and is shown in drawing 3 is completed.
[0046]the collecting electrode plates 36 and 37 -- gas, such as substantia-compacta carbon and a copper plate, -- it is formed of a conductive member [**** / un-], the electric insulating plates 38 and 39 are formed of insulation members, such as rubber and resin, and the end plates 80 and 85 are formed with metal, such as steel provided with rigidity. The output terminals 36A and 37A are formed in the collecting electrode plates 36 and 37, respectively, and an output of the electromotive force produced with the fuel cell constituted by the stack structure 15 is possible. Four pores are provided in the same position corresponding to the collecting electrode plate 36, the electric insulating plate 38, and the end plate 80. For example, the pores 70, 72, 73, and 75 are formed in the end plate 80 (refer to drawing 3). The pore 70 and the pore provided in the same position corresponding to this in the collecting electrode plate 36 and the electric insulating plate 38 form the gas passageway which is open for free passage to the oxidizing gas supply manifold 60 mentioned already, when the stack structure 15 is constituted. The

pore 72 and the pore provided in the same position corresponding to this in the collecting electrode plate 36 and the electric insulating plate 38 form the gas passageway which is open for free passage to the oxidizing gas exhaust manifold 62 mentioned already, when the stack structure 15 is constituted. Similarly the pore 73 and the pore provided in the collecting electrode plate 36 and the electric insulating plate 38 corresponding to this, The pore 75 and the pore provided in the collecting electrode plate 36 and the electric insulating plate 38 corresponding to this form the gas passageway which is open for free passage to the fuel gas exhaust manifold 65 by forming the gas passageway which is open for free passage to the fuel gas supply manifold 63.

[0047]when operating the fuel cell which consists of the stack structure 15, the pore 73 with which the end plate 80 is provided, and the fuel gas feed unit which is not illustrated are connected -- hydrogen -- rich fuel gas is supplied to the inside of a fuel cell. Similarly, when operating a fuel cell, the pore 70 and the oxidizing gas feed unit which is not illustrated are connected, and the oxidizing gas (air) containing oxygen is supplied to the inside of a fuel cell. Here, a fuel gas feed unit and an oxidizing gas feed unit are devices which perform humidification and application of pressure of the specified quantity to each gas, and are supplied to a fuel cell. When operating a fuel cell, the pore 75 and the fuel gas exhaust which is not illustrated are connected, and the pore 72 and the oxidizing gas exhaust which is not illustrated are connected. It is good also as using hydrogen gas with high purity besides [which reformed and obtained hydrocarbon] hydeogen-rich gas as fuel gas.

[0048]Although the built-up sequence of each member when the stack structure 15 is constituted is as having mentioned already, in the field which touches the separator 30, a predetermined sealing member is provided in the periphery of the electrolyte membrane 31. This sealing member prevents fuel gas and oxidizing gas beginning to leak from each inside of a single cell, and it plays the role which prevents fuel gas and oxidizing gas from being mixed in the stack structure 15.

[0049]The stack structure 15 which consists of each member explained above is held where predetermined thrust is applied to the laminating direction, and a fuel cell completes it. About the composition which presses the stack structure 15, since it was not concerned, the graphic display was abbreviated to the important section of this invention. In order to hold pressing the stack structure 15, It is good also as composition which binds the stack structure 15 tight using a bolt and a nut, or the stack member housing of predetermined shape is prepared, It is good also as composition which bends the both ends of stack member housing after storing the stack structure 15 inside this stack member housing, and makes thrust act on the stack structure 15.

[0050]In the above-mentioned explanation, although it presupposed that the separator 30 is formed with the substantia-compacta carbon which compressed carbon and it presupposed gas un-penetrating, it is good also as forming according to different construction material. For example, it is good also as forming with baking body carbon or forming by a metallic member. When forming by a metallic member, it is desirable to choose the metal which has sufficient corrosion resistance. Or it is good also as covering the surface of a metallic member with the material which has sufficient corrosion resistance.

[0051]Although drawing 2 did not indicate, The separator 30 of this example is provided also with the pore for forming the cooling channel through which cooling water other than the pores 40-42 for forming the gas manifold which oxidizing gas passes, and the pores 50-52 for forming the gas manifold which fuel gas passes passes. The electrochemical reaction which advances with a fuel cell is an exoergic reaction, and is maintaining the temperature inside a fuel cell at the predetermined temperature requirement by circulating cooling water in the cooling channel formed of the above-mentioned pore. The pore for forming such a cooling channel can be provided near [in which the pores 40-42, and 50-52 are not formed / remaining] the two sides in the separator 30. Since, as for no composition about circulation of cooling water, there is the Seki straw directly with the important section of this invention, the explanation beyond this about a cooling channel is omitted.

[0052]In order to make the flow of the gas in a single cell intelligible, expressed the crevices 90 and 91 with the separator 30 shown in drawing 1 and drawing 2 like concave structure with the flat bottom, but. Two or more convex structures of the predetermined shape which projects from the bottom are actually

provided in these crevices 90 and 91 and crevices 92 and 93. An example of such a convex structure provided in the crevices 90, 91, 92, and 93 is shown in drawing 4. Drawing 4 (A) is a top view showing signs that a part of pore 40 and crevice 90 were expanded, and drawing 4 (B) is a sectional view showing the situation of the A-A section in drawing 4 (A). As shown in drawing 4, two or more heights 94 which project from the bottom are formed in the crevice 90. A section is an approximately quadrangle, and each heights 94 of these are formed so that it may become same omitting each height. The end of each heights 94 has secured conductivity sufficient by the inside of a fuel cell by the field which touches the adjoining cathode 33 and touches this cathode 33, when the stack structure 15 is assembled. The oxidizing gas which passes through the oxidizing gas passage in a single cell is efficiently supplied to the catalyst bed of the electrolyte membrane 31 surface by colliding with the side of each heights 94 and being spread in the oxidizing gas passage in a single cell.

[0053]Thus, the heights 94 provided in the crevice 90, Sufficient conductivity is secured by touching a gas diffusion electrode at the end, and the gas which passes the gas passageway in a single cell which the crevice 90 forms is diffused, electrochemical reaction is efficiently presented with oxidizing gas, and it has work of raising the capacity factor of gas. The same convex structure as the heights 94 in the crevice 90 is provided also in the crevices 91, 92, and 93, and the same work is carried out. In drawing 4, although the heights 94 considered it as the section abbreviation quadrangle, they are good also as arranging the convex structure of different shape in a different position. It does not arrange dispersedly in each crevice like the heights 94, As a convex structure formed in each crevice, the convex structure of the shape of a rib continuously established along the flow direction of the gas in a channel can be formed, and it can also have composition divided into the fine slot which runs each crevice in parallel mutually, for example. When each crevice formed in the separator surface forms the gas passageway in a single cell within a fuel cell, gas just circulates between the gas manifolds formed of the pore which each crevice makes open for free passage.

[0054]Next, it explains that the fuel gas in the fuel cell provided with the above composition and oxidizing gas flow. First, oxidizing gas is explained. Drawing 5 is an explanatory view which expresses the flow of the oxidizing gas within the stack structure 15 in three dimensions. As mentioned already, the oxidizing gas feed unit formed in the fuel cell exterior, The oxidizing gas (application-of-pressure air) which is connected to the pore 70 provided in the end plate 80, and is supplied from an oxidizing gas feed unit is introduced in the oxidizing gas supply manifold 60 via the pore provided in the position to which the electric insulating plate 38 and the collecting electrode plate 36 correspond. The oxidizing gas which passes through the inside of the oxidizing gas supply manifold 60 is drawn in each single cell 20 in the gas passageway (oxidizing gas passage in a single cell) formed between the cathodes 33 contiguous to the crevice 90 with which each separator 30 is provided. From the oxidizing gas passage in a single cell, the oxidizing gas led to the oxidizing gas passage in these single cells is diffused in the catalyst bed on the electrolyte membrane 31, and electrochemical reaction is presented with it in each single cell. Here, the remaining oxidizing gas that did not participate in electrochemical reaction once goes via the ********** style manifold 61 formed of the pore 41 provided in the separator 30.

[0055]In the ********** style manifold 61, the oxidizing gas which passes each each gas passageway in a single cell gathers, and circulation becomes possible mutually. In this ********** style manifold 61, the oxidizing gas which these-gathered flows downward (refer to drawing 5). In each single cell 20, this oxidizing gas is led to the oxidizing gas passage in a single cell formed between the cathodes 33 contiguous to the crevice 91 with which each separator 30 is provided via the pore 41 with which each separator 30 is provided. From the oxidizing gas passage in a single cell, the oxidizing gas led to the oxidizing gas passage in these single cells is diffused in the catalyst bed on the electrolyte membrane 31, and electrochemical reaction is presented with it in each single cell. Here, the remaining oxidizing gas that did not participate in electrochemical reaction is discharged by the oxidizing gas exhaust manifold 62 formed of the pore 42 provided in the separator 30.

[0056]In the oxidizing gas exhaust manifold 62, in the oxidizing gas supply manifold 60, while oxidizing gas passes for reverse, the oxidizing gas discharged from the oxidizing gas passage in a single cell formed in each single cell 20 joins. If the oxidizing gas which passed the oxidizing gas exhaust

manifold 62 reaches the end of the stack structure 15, it will be discharged by the oxidizing gas exhaust linked to the pore 72 via the pore 72 provided in the end plate 80, and the pore provided in the position to which the collecting electrode plate 36 and the electric insulating plate 38 correspond.

[0057]As mentioned above, although it explained that the oxidizing gas within the stack structure 15 flowed, the same may be said of the fuel gas within the stack structure 15 flowing. The fuel gas feed unit formed in the fuel cell exterior, The fuel gas which is connected to the pore 73 provided in the end plate 80, and is supplied from a fuel gas feed unit, It is introduced via the pore provided in the position to which the electric insulating plate 38 and the collecting electrode plate 36 correspond in the fuel gas supply manifold 63 formed of the pore 50 with which the separator 30 is provided. The fuel gas which passes through the inside of the fuel gas supply manifold 63 is led to the fuel gas flow route in a single cell (formed between the anodes 32 contiguous to the crevice 92) in each single cell 20, and electrochemical reaction is presented with it. The remaining gas that did not participate in electrochemical reaction among the fuel gas which passes the fuel gas flow route in a single cell in each single cell 20 once goes via the fuel gas distribution manifold 64 formed of the pore 51 provided in the separator 30. The fuel gas which went via these fuel gas distribution manifolds passes the fuel gas flow route in a single cell in each single cell 20 (formed between the anodes 32 contiguous to the crevice 93) again, and electrochemical reaction is presented with it. The remaining fuel gas that did not participate in electrochemical reaction is discharged by the fuel gas exhaust manifold 65 formed of the pore 52 provided in the separator 30, joins mutually, and passes through the inside of a fuel gas exhaust manifold for reverse in the fuel gas supply manifold 63. If such fuel gas reaches the end of the stack structure 15, it will be discharged by the fuel gas exhaust linked to the pore 75 via the pore 75 provided in the end plate 80, and the pore provided in the position to which the collecting electrode plate 36 and the electric insulating plate 38 correspond.

[0058]Although the direction into which the gas which passes an inside flows, respectively is for reverse in the above-mentioned explanation at the oxidizing gas supply manifold 60, the oxidizing gas exhaust manifold 62, and the fuel gas supply manifold 63 and the fuel gas exhaust manifold 65, It is good also as composition which gas passes in the same direction with the manifold of a supply side, and the manifold by the side of discharge. That is, the end which connects the oxidizing gas exhaust and the fuel gas exhaust and in which gas is supplied to the end-plate [not the end plate 80 but] 85 side in the stack structure 15 is better also as discharging gas than the end of an opposite hand.

[0059]According to the fuel cell provided with the separator 30 of this example constituted as mentioned above. It has the ********** style manifold and the fuel gas distribution manifold, and as the gas which passes each gas passageway in a single cell passes the gas passageway in a single cell, it once goes via these gas ** style manifold. It originates in the accuracy of the water of condensation mentioned already by this in a part of single cell which constitutes a fuel cell, and the uneven shape formed in the separator surface, Also when the flow of the gas which passes the gas passageway in a single cell has shown dispersion, the gas mass flow which passes the gas passageway in a single cell is equalized by going via a ** style manifold, and dispersion in the gas mass flow which went via the ** style manifold is reduced. For example, in either of the single cells 20 to constitute, a fuel cell for the water of condensation, When the flow of the oxidizing gas which passes through the oxidizing gas passage in a single cell formed of the crevice 90 decreases and the oxidizing gas which passes through the inside of each single cell goes via the ********** style manifold which once gather, It is compensated with oxidizing gas from the single cell arranged in the neighborhood, and the flow of oxidizing gas becomes enough and the amount of oxidizing gas supplied in a specific single cell does not fall too much in the oxidizing gas passage in a single cell formed of the crevice 91. On the contrary, in either of the single cells 20 to constitute, a fuel cell for the water of condensation, Also when the flow of the oxidizing gas which passes through the oxidizing gas passage in a single cell formed of the crevice 91 decreases, in the oxidizing gas passage in a single cell of the upstream formed of the crevice 90, the oxidizing gas of quantity can be enough passed by being open for free passage with a ********** style manifold. Therefore, it can stop that originate in dispersion in the gas mass flow which passes each gas passageway in a single cell, and the performance of a fuel cell falls.

[0060]Drawing 6 is with the fuel cell constituted using the separator 30 of this example, and the fuel cell constituted using the separator 130 shown in drawing 8 as a comparative example, and is the explanatory view which compared current/voltage characteristics. Although the separator 130 has the almost same shape as the separator 30 of this example, The single crevice 190 which does not have the structure corresponding to the pore 41 and the pore 51, for example, is formed continuously and has three flections in one field side of the separator 130 is formed (refer to drawing 8). Therefore, the fuel cell constituted using the separator 130 does not have a ********** style manifold and a fuel gas distribution manifold, and traffic of the gas which passes each gas passageway in a single cell is not once mutually attained on the way like the above-mentioned example. In the separator 130 shown in drawing 8, to the composition which is common in the separator 30, the member number which added 100 to the member number given to the separator 30 is given, and detailed explanation is omitted in it. The heights 94 provided in the crevice 90 of the separator 30 shown in drawing 4 also in the crevice 190 of the separator 130 and the same heights are provided, and the separator 130, In an area equivalent to the case of the separator 30, conductivity shall be secured in contact with an adjoining gas diffusion electrode.
[0061]As shown in drawing 6, the fuel cell which is constituted by the separator 30 and has a ********** style manifold and a fuel gas distribution manifold, It was constituted by the separator 130, and even if output current became large compared with the fuel cell which does not have a ********** style manifold and a fuel gas distribution manifold, higher output voltage was able to be maintained. That is, the fall of the performance of a fuel cell was able to be suppressed by forming a ** style manifold and equalizing the flow of the gas which passes the gas passageway in each single cell.
[0062]The fuel cell constituted using the separator 30, When the situation where the gas flow rate which passes the gas passageway in a single cell falls in some single cells in the single cell which constitutes this fuel cell arises, The effect of equalizing the inclination of the rate of flow of the gas which passes each gas passageway in a single cell not only with the effect of equalizing the gas flow rate in the gas passageway in this single cell but with the whole fuel cell is done so. In each of the fuel cell constituted using the separator 30, and the fuel cell constituted using the separator 130, drawing 7 is an explanatory view showing the result of having investigated the distribution state of the rate of flow of the gas which passes each internal gas passageway in a single cell. Here, each fuel cell consisted of 100 sets of laminated single cells, and used the value which measured the rate of flow in case gas flows into each gas passageway in a single cell from a gas supply manifold as a rate of flow of the gas which passes through the inside of each single cell.
[0063]The rate of flow of the gas which passes through the inside of the gas passageway in a single cell allocated by the upstream (side to which gas supply device and the gas exhaust were connected) end of the fuel cell was set to 100, and the gas flow rate in the remaining gas passageway in a single cell was expressed with this drawing 7 one by one as a relative value over this. Like the example mentioned already, in connecting a gas supply device and the gas exhaust to the end of the same side of a fuel cell, as for a gas flow rate, the upstream which is this connected end becomes late gradually towards the end of an opposite hand (downstream) in a gas flow rate early most. Also in the fuel cell constituted using the separator 30, although a gas flow rate (going to the cell-numbers 100 side from the cell-numbers 1 side in drawing 7) becomes slow toward the above-mentioned upstream to the downstream, As shown in drawing 7, compared with the fuel cell constituted using the separator 130 which is a comparative example, the grade to which a gas flow rate becomes slow toward the downstream is small.
[0064]Thus, according to the fuel cell using the separator 30 of this example, the inclination of the rate of flow of the gas which passes through each channel in a single cell becomes small, and with the whole fuel cell. Since the rate of flow of the gas which passes the gas passageway in a single cell is maintained at a high level, also in the single cell allocated in the above-mentioned downstream, the capacity factor of gas becomes high enough. Therefore, as shown in drawing 6 mentioned already, it is possible that it is that the fuel cell using the separator 30 shows high battery capacity also in the effect that gas flow rate sufficient with the whole fuel cell in this way is maintained.
[0065]When the rate of flow of the gas which passes through each channel in a single cell with the

whole fuel cell becomes quick, It can say that enough many flows of gas are maintained with the whole fuel cell, and the grade which pressurizes the gas supplied to a fuel cell in order to fully secure the gas mass flow in the field whose gas mass flow decreases most can be suppressed. When the capacity factor of gas becomes high enough with the whole fuel cell, the effect that the flow of the gas supplied to a fuel cell can be reduced is also acquired. In order to fully advance electrochemical reaction, the gas of the quantity exceeding the requirements of the gas theoretically calculated from the electric energy made to generate is usually supplied to a fuel cell. If the capacity factor of gas increases as described above, the gas volume supplied superfluously in this way can be stopped. By the ability to suppress the grade of the application of pressure of the gas volume supplied to a fuel cell, and gas, The electric energy consumed in order to stop the quantity of the fuel consumed for power generation or to pressurize the gas supplied to a fuel cell can be suppressed, and the energy efficiency of the whole system provided with a fuel cell can be raised.

[0066]When gas passes the gas passageway in each single cell provided in each single cell in the fuel cell using the separator 30 in the above-mentioned example, gas flows into an abbreviated horizontal direction according to the shape of the crevice established in the separator surface, but. In each whole gas passageway in a single cell, gas flows into a lower part from the upper part. For example, oxidizing gas flows toward the lower part in which the pore 42 was formed from the upper part in which the pore 40 was formed. Therefore, since the water of condensation produced in the gas passageway is also caudad led with the flow of gas, without opposing gravity, wastewater of the water of condensation from the gas passageway in a single cell becomes easy. Here, with the water of condensation produced in a channel, as mentioned already, the produced water which is produced in the cathode side in connection with electrochemical reaction and which was mentioned already, the steam beforehand added to distributed gas in order to prevent desiccation of an electrolyte membrane to a fuel cell before supplying gas, etc. condense within a gas passageway.

[0067]In the fuel cell using the separator 30 of this example, the gas manifold is provided in the side of the fuel cell, and the gas supplied to each single cell flows in sideways to each gas passageway in a single cell. Therefore, it can stop that the water of condensation produced in the gas manifold takes up near a terminal area with the gas manifold in each gas passageway in a single cell, and bars the flow of gas. On the other hand, when the gas manifold is provided in the upper and lower sides of the fuel cell and gas is supplied from an upper gas manifold to each gas passageway in a single cell, the water of condensation in this gas manifold flows into the gas passageway in a single cell easily, and there is a possibility of blockading a gas passageway.

[0068]In the separator 30 of the example mentioned already, the surface is quadrisected horizontally, In the field side which every two divided fields were made to continue, for example, was shown in drawing 2, we considered it as the crevice 90 and the crevice 91, and decided to form the single ********** style manifold 61 by the pore 41 which makes these crevices 90 and 91 open for free passage. Here, an oxidizing gas (or fuel gas) ** style manifold is good also as providing more than one, and is shown in drawing 9 by making an example of the separator of such composition into the separator 230. Although the surface of one of these is horizontally quadrisected like the separator 30, the separator 230 shown in drawing 9, When this divided field forms four respectively separate crevices (crevice 290,291,292,293) and a fuel cell is constituted using the separator 230, these crevices form the oxidizing gas passage in a single cell between adjoining gas diffusion electrodes. The separator 230 is provided with five pores (pores 240 and 241,242,243,244). When a fuel cell is constituted using the separator 230, these pores form the gas manifold which oxidizing gas passes.

[0069]Here, the pore 240 forms an oxidizing gas supply manifold, and this oxidizing gas supply manifold distributes the oxidizing gas supplied from the outside to the gas passageway in each single cell. The pore 242 forms an oxidizing gas exhaust manifold, and this oxidizing gas exhaust manifold makes the oxidizing gas discharged from the channel in each single cell join, and it leads it to the exterior of a fuel cell. The pore 241,243,344 forms a ********** style manifold and the oxidizing gas which passes through the oxidizing gas passage in each single cell formed in the single cell which constitutes a fuel cell once goes via each of these ********** style manifolds, respectively.

[0070]The crevice 291 makes the pore 243 and the pore 241 open for free passage, the crevice 292 makes the pore 241 and the pore 244 open for free passage, and the crevice 293 makes the pore 244 and the pore 242 for the above-mentioned crevice 290 to make the pore 240 and the pore 243 open for free passage, and open for free passage. Therefore, the oxidizing gas supplied from the outside is first introduced into the oxidizing gas passage in a single cell formed of the crevice 290 via the oxidizing gas supply manifold formed of the pore 240. The oxidizing gas which passed through the oxidizing gas passage in this single cell passes through the oxidizing gas passage in a single cell formed of the crevice 291, after going via the ********** style manifold formed of the pore 243. Then, repeat the same operation and it goes via the ********** style manifold formed of the pore 241, After going via the ********** style manifold which passes through the oxidizing gas passage in a single cell formed of the crevice 292, and is formed of the pore 244, It passes through the oxidizing gas passage in a single cell formed of the crevice 293, and is discharged by the exterior of a fuel cell via the oxidizing gas exhaust manifold formed of the pore 242.
[0071]According to the fuel cell constituted using such a separator 230, equalize the flow of the oxidizing gas supplied to the gas passageway in each single cell like the above-mentioned example using the separator 30, and. The rate of flow of gas can be kept high enough with the whole fuel cell, and it can prevent the performance of a fuel cell falling. Since there are many ********** style manifolds compared with the case where the separator 30 is used especially, the effect which equalizes the flow of the oxidizing gas which passes through the inside of each single cell can be heightened further.
[0072]Although we decided to form a gas ** style manifold by both the channel of oxidizing gas, and the channel of fuel gas in the fuel cell using the separator 30 of the example mentioned already, It is good also as providing only in one of channels, and a suitable effect is acquired also when such a gas ** style manifold is formed in one of channels. Although we decided that the manifold which fuel gas passes provides only a couple and a gas ** style manifold is formed only in the oxidizing gas passage side in the separator 230 shown in drawing 9, the above-mentioned effect by equalizing the flow of oxidizing gas also in such a case can fully be acquired. The above-mentioned effect by the flow of fuel gas equalizing from the first also as forming a ** style manifold only in the fuel gas flow route side can be acquired. In forming a gas ** style manifold only in one of channels, in order to form a gas ** style manifold in the gas passageway of another side, it is not necessary to provide a pore, and shaping of a separator becomes easier.
[0073]Although the surface of the separator was horizontally quadrisected in the example mentioned already, it is good also as dividing the separator surface into a different number and forming a gas ** style manifold. Such an example is shown below. Drawing 10 is a top view showing the composition of the separator 330 which divided the separator surface into two horizontally. In the fuel cell constituted using the separator 330, the oxidizing gas passage in a single cell is formed of the crevice 390,391 which divided the surface of the separator 330 two and was provided. moreover -- such a fuel cell -- of the pore 342, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 340, it is formed, and a ********** style manifold is formed of the pore 343. The oxidizing gas distributed to each single cell from the oxidizing gas supply manifold, It passes through the oxidizing gas passage in a single cell which the crevice 390 forms, the gas passageway in a single cell which the crevice 391 forms after that is passed via [a ********** style manifold] once, and it is discharged outside via an oxidizing gas exhaust manifold.
[0074]The top view showing the composition of the separator 430 which trichotomized the separator surface is shown in drawing 11. In the fuel cell constituted using the separator 430, the oxidizing gas passage in a single cell is formed of the crevice 490,491,492 which trichotomized the surface of the separator 430 horizontally and was provided. moreover -- such a fuel cell -- of the pore 442, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 440, it is formed, and a ********** style manifold is formed of the pore 443,444. The oxidizing gas distributed to each single cell from the oxidizing gas supply manifold passes through the oxidizing gas passage in a single cell which each of the crevice 490,491,492 forms one by one. In that case, it goes via the **********

style manifold which makes the continuous oxidizing gas passages in [of two] a single cell open for free passage one by one. The oxidizing gas which passed the gas passageway in a single cell which the crevice 492 forms is discharged outside via an oxidizing gas exhaust manifold.
[0075]Drawing 12 is a top view showing the composition of the separator 530 which divided the separator surface into six. One surface of the separator 530 is made open for free passage, respectively, three of every fields which divided the surface of the separator 530 into six horizontally are provided in it, and the crevice 590,591 which has two flections, respectively is established in it. In the fuel cell constituted using the separator 530, the oxidizing gas passage in a single cell is formed of these crevices 590,591. moreover -- such a fuel cell -- of the pore 542, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 540, it is formed, and a ********** style manifold is formed of the pore 543. The oxidizing gas distributed to each single cell from the oxidizing gas supply manifold, It passes through the oxidizing gas passage in a single cell which the crevice 590 forms, the gas passageway in a single cell which the crevice 591 forms after that is passed via [a ********** style manifold] once, and it is discharged outside via an oxidizing gas exhaust manifold. Although the pore for forming a ********** style manifold decided to provide only one place in the separator 530, in order to form two or more ********** style manifolds, it is good also as providing many pores. For example, it is good also as providing a pore in the flection which the crevice 590 and the crevice 591 have, and forming a ********** style manifold further by such a pore.
[0076]Thus, by dividing the separator surface into two or more fields, forming the crevice for forming the gas passageway in a single cell, and forming a gas ** style manifold by these crevices and a pore open for free passage, The flow of the gas which passes the gas passageway in a fuel cell can be equalized, and the effect mentioned already can be acquired. Although while showed drawing 10 - drawing 12 and the above explanation explained the field side, i.e., an oxidizing gas passage, to them, Also about the fuel gas flow route provided in another field side, by having same composition, the flow of the gas which passes a gas passageway can be equalized and the performance of a fuel cell can be raised. Here, shape of the crevice formed in the separator surface is made fine, the gas mass flow which passes the position of the gas passageway in a single cell increases, the diffusibility of gas improves, and the rate of gas utilization increases, so that the cross-section area of the gas passageway formed of such a crevice is made small. Since the water of condensation becomes is easy to be blown away and the water of condensation becomes difficult to stagnate in the gas passageway in a single cell so that the gas mass flow which passes the gas passageway in a single cell increases and a gas flow rate becomes quick, the wastewater nature in the gas passageway in a single cell improves. However, if a passage sectional area is made small in this way, the pressure loss at the time of gas passing the gas passageway in a single cell will also go up. The energy required in order that the rise of the pressure loss at the time of gas passing may pressurize the gas supplied to a fuel cell is made to increase, and there is a possibility of leading to decline in the energy efficiency of the whole system provided with a fuel cell. Therefore, what is necessary is just to determine the fineness of the shape of a crevice suitably in consideration of the effect that the rate of gas utilization improves by making it fine, the process tolerance demanded when forming the influence of the pressure loss which increases by this, and a separator, etc.
[0077]The crevice formed in the separator surface in order to form the gas passageway in a single cell is made to diffuse the gas which passes through a channel in explanation of the separator 30, as shown in drawing 4, and two or more heights which secure conductivity between a separator and a gas diffusion electrode are provided in it. Here, if the shape of the crevice established in the separator surface is fine enough and the diffusibility of gas and the conductivity between gas diffusion electrodes are fully secured, it is not necessary to establish such a convex structure corresponding to the heights 94 in a crevice.
[0078]Although the all once considered the gas which passes the gas passageway in a single cell formed of the predetermined crevice established in the separator surface via the gas ** style manifold in the example mentioned already as the composition which flows into each single cell again after that, A part of gas which passes the gas passageway in a single cell is good also as composition which does not go via a gas ** style manifold. As an example of such composition, the composition (composition by the

side of the field which forms an oxidizing gas passage) of the separator 630 is shown in drawing 13. The separator 630 is provided with the crevice 690 which quadrisected the surface horizontally and made these open for free passage one by one, and the pore 640,641,642. In the fuel cell constituted using the separator 630. After the oxidizing gas supplied to each single cell from the oxidizing gas supply manifold formed of the pore 640 passes through the oxidizing gas passage in a single cell formed of the crevice 690, it is discharged by the oxidizing gas exhaust manifold formed of the pore 642, and is drawn out of a fuel cell.

[0079]Here, the crevice 690 which forms the oxidizing gas passage in a single cell is a field where the shape is crooked on the separator 630, and is open for free passage with the pore 641 which forms a ********** style manifold. In the separator 30 of the example mentioned already, although the crevices 90 and 91 are open for free passage via the pore 41, they are divided by the pore 41 as a structure of a crevice. The crevice 690 with which the separator 630 is provided is not necessarily divided by the pore 641 in this way, and is opening from the pore 640 to the pore 642 for free passage by the crevice structure formed continuously. That is, although the pore 641 is open for free passage with this crevice 690 in the end (outside of crookedness) at which the crevice 690 is crooked and it is formed along with one side of the separator 630, the crevice is formed continuously, without the field (inside of crookedness) which adjoins the pore 641 being divided by the pore 690. Therefore, although a part of oxidizing gas which passes through the oxidizing gas passage in a single cell once goes via the ********** style manifold formed of the pore 641 on the way, Without going via a ********** style manifold, the remaining oxidizing gas passes through the oxidizing gas passage in a single cell which the crevice 690 forms, and is discharged by the oxidizing gas exhaust manifold. In drawing 13, although only the situation by the side of one field of the separator 630 (side which forms the oxidizing gas passage in a single cell) was shown, the field side (side which forms the fuel gas flow route in a single cell) of another side is formed similarly. Namely, the fuel gas supplied to each single cell from the fuel gas supply manifold, Can draw the fuel gas flow route in a single cell which the crevice 690 and the same crevice form, and the part goes via the fuel gas distribution manifold which the pore 641 and the same pore form, and. The remaining fuel gas is drawn to a fuel gas exhaust manifold by the fuel gas flow route in a single cell which the above-mentioned crevice forms, without going via a fuel gas distribution manifold.

[0080]According to the separator 630 of such composition, in the field in which a crevice (gas passageway in a single cell) is crooked. By passing a part of gas which passes the gas passageway in a single cell, without making it go via a ** style manifold, the pressure loss of the gas in such a flection can be stopped, and the bias of the flow of gas can be stopped. As mentioned already, when the composition which makes small the passage sectional area of the gas passageway in a single cell formed on a separator increases the gas mass flow and the rate of flow which pass through the inside of a channel, it is useful. However, in order to make a passage sectional area small, when providing a flection (part which changes the flow direction of gas) in the gas passageway in a single cell like the example mentioned already, in such a flection, the pressure loss of gas becomes large, and the flow of gas will be confused and a bias will be produced with a flow. Although what is necessary is just to expand the depth in a flection in order to reduce the pressure loss in a flection, in order to expand the depth in a flection, it is necessary to enlarge a pore with the composition which divides a crevice by a pore like the example mentioned already. Such composition will enlarge area of a pore to the whole separator, and the rate of an available area falls to electrochemical reaction, and it cannot adopt it as it easily. If it has composition which a crevice follows by the inside of a flection like the above-mentioned separator 630, it can suppress that can fully secure the depth in a flection, without enlarging area of a pore, a channel is narrowed down by a flection, and a pressure loss increases.

[0081]The separator 630 which established the communicating structure whose passage of gas is attained without drawing 14 going via a gas ** style manifold in the flection of the gas passageway in a single cell, It is a fuel cell using each with the separator 30 which divided the crevice by the pore by the above-mentioned flection, and is an explanatory view showing the result of having carried out the simulation of signs that gas flows. Drawing 14 (A) expresses the result of having used the separator 630,

drawing 14 (B) expresses the result of having used the separator 30, and all express the pressure distribution in a gas ** style manifold on the field of a predetermined separator. As shown in drawing 14 (B), in using a separator provided with the crevice divided by the pore, within the gas ** style manifold which a pore forms, a very high pressure arises and the pressure loss at the time of gas passing the gas passageway in a single cell by this becomes large. On the other hand, as shown in drawing 14 (A), when using a separator provided with the crevice which has the communicating structure which can pass gas, without going via a ** style manifold, the pressure produced within a gas ** style manifold is reduced, and the pressure loss at the time of gas passing the gas passageway in a single cell is stopped.
[0082]Although drawing 14 showed only the pressure distribution in a gas ** style manifold, In the gas passageway in a single cell connected to a gas ** style manifold by adjoining a gas ** style manifold and establishing the above-mentioned communicating structure, the effect of a pressure loss being stopped and also being hard to produce the bias of the flow of gas is acquired. Producing a high pressure especially by the predetermined part in a gas ** style manifold, as shown in drawing 14 (B). If the pressure loss of the gas at the time of passing through the inside of a ** style manifold is large, in the downstream of a gas ** style manifold, a bias will arise with the flow of gas -- the field to which the rate of flow of gas falls remarkably produces. Thus, if the flow of gas becomes uneven by the gas passageway in a single cell, the efficiency in which electrochemical reaction advances will vary by a place. If a gas ** style manifold is adjoined and the above-mentioned communicating structure is established like [in the case of using the separator 630], it can stop that a bias arises with the flow of gas, and the efficiency of electrochemical reaction can fully be secured on the field of the whole separator.
[0083]Also when the composition which adjoins a gas ** style manifold like the separator 630, and establishes the above-mentioned communicating structure miniaturizes a fuel cell more, it is effective. Namely, although the composition which makes the pore for forming a gas manifold smaller as composition which miniaturizes a fuel cell can be considered without reducing battery capacity, If a gas ** style manifold is adjoined and the above-mentioned communicating structure is established, even if it makes a pore small in this way, the pressure loss at the time of gas passing can become large too much, and it is sufficient, and can stop that the inconvenience that the flow of gas worsens arises. In such a case, since a part of gas which passes the gas passageway in a single cell goes via a gas ** style manifold, miniaturizing a fuel cell, can acquire the effect which equalizes a gas mass flow, and. By not going via a gas ** style manifold, the remaining gas can secure the flow of sufficient gas.
[0084]In the separator of the example mentioned already, the gas passageway in a single cell which the crevice provided on the separator forms is open for free passage with the gas ** style manifold in the flection by which the flow direction of the gas which passes through the inside of this channel is changed. Here, the pore which is provided in a separator and forms a gas ** style manifold within a fuel cell is formed along with the predetermined neighborhood in the periphery of a separator. In such a separator, it is also desirable for the distance of the rim of a separator and the above-mentioned pore to have composition which becomes large in the end of a pore. Such composition is explained using drawing 15.
[0085]Drawing 15 (A) expresses the composition to which the distance of the rim of a separator and the above-mentioned pore becomes large in the end of a pore, and drawing 15 (B) expresses composition with a constant distance of the rim of a separator, and the above-mentioned pore. Although drawing 15 expresses only the neighborhood of the end of the pore which forms a gas ** style manifold among the structures of a separator, The separator shown in drawing 15 (B) was the same as the separator 30 of the example mentioned already, and it has the same composition as the separator 30, and other parts which the separator 30A shown in drawing 15 (A) does not illustrate, either gave the same number as the separator 30 to the common member, and omitted explanation. The separator 30A is provided with the pore 41A which forms a ********** style manifold like the pore 41 in the separator 30. In the end of the pore 41A, only the side near the rim of the separator 30A inclines gently inside the separator 30A, and the periphery of the pore 41A is formed so that the end of the pore 41A may become thin gradually by this.

[0086]According to the separator 30A constituted in this way, the fuel cell which was more excellent in endurance can be constituted. As mentioned already, in forming a gas ** style manifold by the pore provided in the separator, In order that the gas which passes the gas passageway in a single cell may change a flow direction in the flection of the gas passageway in a single cell in which the gas ** style manifold was formed (refer to the solid line arrow in drawing 15 (B)), In each separator which constitutes a fuel cell, the power of going to the outside direction of a separator works in the pore which forms a gas ** style manifold (refer to the dashed line arrow in drawing 15 (B)). Especially in the separator peripheral area near the end of the pore which forms a gas ** style manifold, such outward stress is concentrated and committed with each separator. Thus, the position which power concentrates and is committed is illustrated in the separator 30 of drawing 15 (B). Although enlargement of a fuel cell is suppressed by bringing the pore 41 close to the rim of the separator 30 as much as possible, and providing, Thus, if distance of the pore 41 and a separator rim is made small, as shown in drawing 15 (B), stress will concentrate on a thin member, and it will become a problem when fully securing the intensity and endurance of a fuel cell. If the pore 41A is formed like the separator 30A shown in drawing 15 (A) so that distance with the rim of a separator may become large in the end, sufficient intensity to the above-mentioned stress can be realized, and the endurance of a fuel cell can fully be secured. As described above, in order to attain desired intensity according to the composition to which the shape of the pore 41A is made for distance with the rim of a separator to become large in the end, without forming the whole pore 41A in the distance more from a separator rim, In order to secure the intensity of a separator, the whole separator and by extension, the whole fuel cell are not enlarged.

[0087]When forming the shape of the pore 41A so that distance with the rim of a separator may become large in the end, as shown in drawing 15 (A), If only the side near the rim of the separator 30A among the peripheries of the pore 41 considers it as the shape which inclines gently inside the separator 30A as it goes to the end of the pore 41, the gas which passes the gas passageway in a single cell is led to this shape that inclines gently, and it can be more smoothly flowed through it. Like drawing 15 (B), if the corner is formed in the end of the pore 41, the gas which passes the flection of the gas passageway in a single cell will produce a turbulent flow in this corner, and the pressure loss of gas will become still larger by this. By forming a channel like drawing 15 (A) in accordance with the direction into which gas flows, such a pressure loss can be stopped and the flow of gas can be made smooth. Although the channel side of oxidizing gas was expressed with drawing 15, the above-mentioned effect can be acquired by forming a gas ** style manifold in the channel side of fuel gas by a same-shaped pore. Although only one side was expressed with drawing 15 among the ends of the pore which forms a gas ** style manifold, the above-mentioned effect of securing the intensity of a separator and making the flow of gas smooth can be further enlarged by considering it as the shape which described both ends above.

[0088]Although the pore which forms a gas ** style manifold decided that the flection of the crevice which forms the gas passageway in a single cell, i.e., near the peripheral part of a separator, provides in the example mentioned already, Even if it forms a gas ** style manifold by the pore provided in the field to which separators differ, the effect which equalizes the rate of flow of the gas which passes a gas passageway can be acquired. An example of such composition is shown in drawing 16 and drawing 17 as the separator 730 and the separator 830, respectively.

[0089]Drawing 16 is a top view showing the composition (composition by the side of the field which forms an oxidizing gas passage) of the separator 730. The surface of the separator 730 is quadrisected horizontally and the crevice 790,791,792,793 is established in each divided field. In the fuel cell constituted using the separator 730. The crevice 790,791,792,793 established in the surface of the separator 730, This order is open for free passage, the oxidizing gas passage in a single cell is formed, of the pore 742, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 740, it is formed, and a ********** style manifold is formed of the pore 743,744,745.

[0090]Although the pore 743 makes the crevices 790 and 791 open for free passage, the pore 744 makes the crevices 791 and 792 open for free passage here and the pore 745 is making the crevices 792 and 793 open for free passage, Unlike the pore which forms a gas ** style manifold in the example mentioned

already, these pores are provided in the central part twist from that of the separator. That is, it does not provide in the flection projected toward the separator peripheral part from the crevice established in the separator surface, but it is provided so that the end sides of the crevice which adjoins each other may be opened for free passage (refer to drawing 16).

[0091]Drawing 17 is a top view showing the composition (composition by the side of the field which forms an oxidizing gas passage) of the separator 830. The surface of the separator 830 is trichotomized horizontally, near [the] the 2nd step of middle forms the crevice 890 continuously with the first step, and even the 3rd step forms the crevice 891 continuously from near the 2nd step of middle. As for the connection section of the crevice 890 and the crevice 891, i.e., near the central part of the separator 830, the pore 843 which makes these crevices open for free passage is formed (refer to drawing 17). In the fuel cell constituted using the separator 830. This order is open for free passage, and the crevice 890,891 established in the surface of the separator 830 forms the oxidizing gas passage in a single cell, Of the pore 842, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 840, it is formed, and a ********** style manifold is formed of the pore 843.

[0092]Although we decided to form such a gas ** style manifold only in the channel side of oxidizing gas in the separators 730 and 830 shown in drawing 16 and drawing 17, it is good also as forming the same gas ** style manifold also as the channel side of fuel gas.

[0093]Thus, the pore which forms a gas ** style manifold, The gas ** style manifold good also as providing in which field on a separator and formed of a pore, If the gas which is open for free passage with the gas passageway in each single cell formed of the crevice established in the separator surface, and passes through the inside of each single cell is able to once go via this gas ** style manifold, The effect of making the flow of the gas which passes the gas passageway in a fuel cell equalizing can be acquired. Therefore, it adds to the number of partitions on the separator for providing a crevice, or the number of ** style manifolds, They can be designed freely, the position of the pore for forming a ** style manifold, etc. taking into consideration suitably the energy efficiency of the whole system provided with a fuel cell, the restrictions on the space in which a fuel cell should be installed, etc.

[0094]As for this invention, although the example of this invention was described above, it is needless to say that it can carry out with the aspect which becomes various within limits which are not limited to such an example at all and do not deviate from the gist of this invention.

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Field of the Invention]This invention about the distribution method of the gas in the gas separator for fuel cells, a fuel cell, and a fuel cell in detail, In the fuel cell which carries out the plural laminates of the single cell, and constitutes it, it is provided between the adjoining single cells, and form a fuel gas flow route and an oxidizing gas passage between the adjoining members, and. It is related with the distribution method of the gas in the fuel cell using the separator for fuel cells which separates fuel gas and oxidizing gas, and this separator, and this fuel cell.

[Translation done.]

PRIOR ART

[Description of the Prior Art]The gas separator for fuel cells is a member which constitutes the fuel cell stack by which two or more single cells were laminated, and has prevented mixing the fuel gas and oxidizing gas which are supplied to each of an adjacent single cell by having sufficient gas impermeability. Such a separator for fuel cells usually has rugged structure, such as the shape of a rib, on the surface.
It also has the work which forms the channel of fuel gas and oxidizing gas (the gas separator of such composition is also called interconnector with a rib).
That is, the separator for fuel cells forms the channel (gas passageway in a single cell) of fuel gas or oxidizing gas between the adjoining member (gas diffusion layer) and the above-mentioned rugged structure, when included in a fuel cell stack.
[0003]The gas separator for fuel cells has a predetermined hole structure other than the rugged structure which usually forms the above-mentioned gas passageway. the corresponding hole with which the adjacent gas separator was equipped when a single cell provided with such a gas separator was laminated and a fuel cell stack was constituted -- structures lap -- these holes -- the gas manifold which pierces through the inside of a fuel cell stack to the laminating direction is formed of structure. Such a gas manifold gathers a fuel exhaust gas or oxidation exhaust gas after distributing to each single cell, making the inside pass the fuel gas or oxidizing gas supplied from the outside of a fuel cell or presenting electrochemical reaction by each single cell, and makes these flow into the fuel cell exterior. Therefore, the gas manifold formed of the above-mentioned hole structure is open for free passage with the above-mentioned gas passageway in a single cell (the oxidizing gas passage in a single cell, or the fuel gas flow route in a single cell) formed in each laminated single cell.
Gas flows out between a gas manifold and the channel in a single cell, and ON is possible.

[0004]Drawing 18 is an explanatory view which expresses the composition of the separator 930 superficially as an example of the gas separator for fuel cells known conventionally. the separator 930 -- the circumference near [the] -- four holes -- it has the pore 940,942,950,952 as a structure. When these pores laminate two or more single cells which consist of a member containing the separator 930 and constitute a fuel cell, The corresponding pores with which the adjacent separator 930 is provided lap, and inside a fuel cell, Respectively An oxidizing gas supply manifold (the oxidizing gas supplied from the outside is distributed to each oxidizing gas passage in a single cell), An oxidizing gas exhaust manifold (the oxidation exhaust gas discharged from each oxidizing gas passage in a single cell is gathered, and it leads out of a fuel cell), A fuel gas supply manifold (the fuel gas supplied from the outside is distributed to each fuel gas flow route in a single cell) and a fuel gas exhaust manifold (the fuel exhaust gas discharged from each fuel gas flow route in a single cell is gathered, and it leads out of a fuel cell) are formed.
[0005]The crevice 990 which makes the pore 940 and the pore 942 open for free passage is established in one field of the separator 930.
The crevice (not shown) which makes the pore 950 and the pore 952 open for free passage is established

in the field of another side of the separator 930.
Both these crevices have the grooved structure of having two flections on the way. When the member containing the separator 930 is laminated and a fuel cell is constituted, these crevices form the gas passageway in a single cell between the members which adjoin the separator 930. That is, the crevice 990 which makes the pore 940 and the pore 942 open for free passage forms the oxidizing gas passage in a single cell, and the crevice which makes the pore 950 and the pore 952 open for free passage forms the fuel gas flow route in a single cell. The oxidizing gas supplied to the fuel cell passes through the inside of the oxidizing gas supply manifold formed of the pore 940, After being distributed to the oxidizing gas passage in a single cell formed in each single cell and presenting electrochemical reaction, it joins by the oxidizing gas exhaust manifold formed of the pore 942, and is discharged by the fuel cell exterior. Similarly the fuel gas supplied to the fuel cell passes through the inside of the fuel gas supply manifold formed of the pore 950, After being distributed to the fuel gas flow route in a single cell formed in each single cell and presenting electrochemical reaction, it joins by the fuel gas exhaust manifold formed of the pore 952, and is discharged by the fuel cell exterior.
[0006]Especially in the separator 930 shown in such drawing 18. Since the crevice provided on each field of the separator 930 serves as shape in which only half one round trip is crooked, compared with the case where shape straight in this way is not used, the passage cross section of the gas passageway in a single cell becomes small, and the rate of flow of the gas which passes through the arbitrary places of a channel can be made quicker. Therefore, the gas which passes through the inside of the gas passageway in a single cell is better stirred in a channel, and will be in the state where it is spread. By being in such a state, the electrode active material (hydrogen or oxygen) in gas (fuel gas or oxidizing gas) contacts easily the catalyst bed provided on the electrode, and an electrode active material becomes is easy to be used by electrochemical reaction, and the capacity factor of gas improves.
[0007]As shape of the crevice established in the surface of the gas separator for fuel cells other than composition of having been shown in drawing 18, As described above, on the same flat surface, establish respectively two or more crevices of the shape where only half one round trip was crooked in parallel, and two or more crevices on these same fields are received, The composition which performs the feeding and discarding of gas is proposed via the gas introduction hole and gas discharge hole of a couple which form a gas supply manifold and a gas exhaust manifold (for example, JP,7-263003,A etc.). Since the passage cross section of the gas passageway in a single cell will become still smaller and the rate of flow of the gas which passes through the arbitrary places in a channel will become quicker by providing two or more crevices of the crooked shape on the same flat surface if it has such composition, the capacity factor of the gas in a fuel cell can be raised further.

[Translation done.]

EFFECT OF THE INVENTION

[The means for solving a technical problem, and its operation and effect] It is a fuel cell which acquires electromotive force according to the electrochemical reaction which the fuel cell of this invention carried out the plural laminates of the single cell, and used gas in each single cell, The gas passageway in a single cell for being provided respectively succeeding the inside of said each single cell, passing said gas, and spreading this gas in said each single cell, The gas supply manifold which distributes said gas which flows from the outside of said fuel cell, and is supplied to the gas passageway in said each single cell, The gas exhaust manifold which collects said gas discharged from the gas passageway in said each single cell, and is made to flow into the exterior of said fuel cell, Let it be a gist to penetrate said each gas passageway in a single cell to the laminating direction of said single cell, respectively, and to equip it with the ** style manifold which enables traffic of said gas between said each gas passageway in a single cell.
[0016]The plural laminates of the single cell are carried out, a gas supply manifold distributes gas which flows from the outside of a fuel cell, and a fuel cell of this invention constituted as mentioned above supplies it to a gas passageway in each single cell. A gas passageway in a single cell provided in each single cell passes said supplied gas, and spreads this gas in each single cell. In each single cell, electromotive force is acquired according to electrochemical reaction using this gas. To a fuel cell, said each gas passageway in a single cell is penetrated in a laminating direction of said single cell, respectively, A ** style manifold which enables traffic of said gas between said each gas passageway in a single cell is formed, and when said gas passes each gas passageway in a single cell, it goes via this ** style manifold. Said gas discharged from a gas passageway in said each single cell is brought together in a gas exhaust manifold, and flows into the exterior of a fuel cell.
[0017]A distribution method of gas in a fuel cell of this invention, It is a distribution method of gas in a fuel cell which acquires electromotive force according to electrochemical reaction which carried out the plural laminates of the single cell, and used this gas in response to supply of gas, (a) said supplied gas in a process distributed to a gas passageway in a single cell formed in an inside of each of said single cell via a gas supply manifold in which it was provided by said fuel cell, and said single cell of each (b) from said fuel cell outside, Said gas distributed from said gas supply manifold, passing a gas passageway in said single cell. A process with which electrochemical reaction [each] which advances by said single cell is presented, and said gas discharged from a gas passageway in each of said single cell after the (c) aforementioned electrochemical reaction was presented, Have a process of discharging gas which gathered a gas exhaust manifold provided in said fuel cell, and this gathered out of said fuel cell, and the aforementioned (b-1) (b) process, Let it be a gist to have further a process which makes it go via a ** style manifold formed in a laminating direction of said single cell by penetrating in an inside of said fuel cell in said at least a part of each of said single cell gas which passes a gas passageway in said single cell.
[0018]Since gas which passes a gas passageway in a single cell goes via a ** style manifold according to the distribution method of gas in a fuel cell of such this invention, and a fuel cell of this invention, In either of the single cells which constitute a fuel cell, when a supply state of gas gets worse, performance

of the whole fuel cell can be prevented from output voltage declining and falling. Namely, in either of the single cells by stagnation of the water of condensation, etc. When passage resistance at the time of gas flowing into a gas passageway in a single cell increases, a supply state of gas gets worse and gas which passes a gas passageway in a single cell goes via a ** style manifold, By a gas passageway in a single cell of the downstream, it becomes possible to fully secure the amount of supply of gas rather than a terminal area with this ** style manifold. Therefore, even if stagnation of the water of condensation, etc. take place, a supply state of gas does not get worse in the whole single cell in which this water of condensation stagnated.
[0019]Since gas which passes a gas passageway in each single cell goes via a ** style manifold according to the distribution method of gas in a fuel cell of this invention, and a fuel cell of this invention, with the whole fuel cell. An effect that a flow (or the rate of flow) of gas which passes a gas passageway in each single cell can be equalized is done so. In a ** style manifold, since traffic of gas between each gas passageway in a single cell is possible, when a flow of gas which passes each gas passageway in a single cell has dispersion, they are equalized. Inside a fuel cell, predetermined inclination arises in a gas mass flow which passes through inside of each single cell according to a flow direction (flow direction of gas which passes through inside of a gas exhaust manifold) of gas by which feeding and discarding are carried out from the outside. Since the above-mentioned inclination can be made small if a gas mass flow which forms a ** style manifold and passes a gas passageway in each single cell like a distribution method of gas in a fuel cell of this invention and a fuel cell of this invention is equalized, By each single cell which constitutes the whole fuel cell, a flow of gas can fully be secured and the amount of electrochemical reaction which advances by each single cell can be maintained on a high level.
[0020]A fuel cell of this invention is good also as having two or more said ** style manifolds. If it has such composition, it originates in the water of condensation etc., and influences by supply of gas being barred in a predetermined single cell are reduced, and an effect which equalizes a flow of gas which passes each gas passageway in a single cell can be heightened further.
[0021]In a fuel cell of this invention, said gas is good also as being the fuel gas containing hydrogen. If it has such composition, in a channel of fuel gas formed in a fuel cell, the above-mentioned effect can be acquired and battery capacity (stable output voltage) of a fuel cell can be maintained highly enough.
[0022]In a fuel cell of this invention, said gas is good also as being the oxidizing gas containing oxygen. If it has such composition, in a channel of oxidizing gas formed in a fuel cell, the above-mentioned effect can be acquired and battery capacity (stable output voltage) of a fuel cell can be maintained highly enough.
[0023]A gas separator for fuel cells of this invention is used for a fuel cell which laminates two or more single cells, is a gas separator for fuel cells which constitutes said single cell with a member which forms an electrolyte layer and an electrode, and comprises the following:
Three or more holes for penetrating this gas separator for fuel cells to the thickness direction, respectively, being provided, and forming a part of gas manifold of said fuel cell, respectively.
in one field top of said gas separator for fuel cells -- up to the 2nd predetermined hole from the 1st predetermined hole among said three or more holes -- these 1st and 2nd holes -- a crevice for being provided so that said field top may be made to open for free passage via a hole of an except one by one, and forming a gas passageway in said single cell.

[0024]Such a gas separator for fuel cells is used for a fuel cell which has three or more holes provided in the thickness direction by penetrating, constitutes a single cell with a member which forms an electrolyte layer and an electrode, and laminates and constitutes two or more single cells. When a fuel cell is constituted using a gas separator for fuel cells of this invention, said three or more holes form a gas manifold of said fuel cell, respectively. moreover -- up to the 2nd hole predetermined [from the 1st predetermined hole among said three or more holes] in a gas separator for fuel cells of this invention to field top of one of these -- these 1st and 2nd holes -- it has a crevice which makes said field top open for free passage via a hole of an except one by one. When a fuel cell is constituted using a gas separator for

fuel cells of this invention, this crevice forms a gas passageway in a single cell between adjoining members. A gas passageway in a single cell formed of this crevice is open for free passage with a gas manifold formed of each of said three or more holes. In such a fuel cell, if gas is supplied from the exterior of a fuel cell to a gas manifold formed of the 1st predetermined hole, supplied gas will be distributed to a gas passageway in each single cell from this gas manifold. Gas discharged by passing a gas passageway in a single cell is brought together in a gas manifold formed of the 2nd predetermined hole, and can be made to flow into the fuel cell exterior at this time. thus -- the time of gas passing a gas passageway in a single cell -- this gas -- said 1st and 2nd holes -- it goes via a gas manifold formed of a hole of an except.
[0025]According to such a gas separator for fuel cells, a fuel cell of this invention and same fuel cell can be constituted, and the same effect as a fuel cell of this invention can be acquired in such a fuel cell. Therefore, by using a gas separator for fuel cells of this invention, in either of the single cells which constitute a fuel cell, when a supply state of gas gets worse, a fuel cell without a possibility that output voltage may decline and performance of the whole fuel cell may fall can be constituted. Equalize a flow of gas which passes each gas passageway in a single cell by using a gas separator for fuel cells of this invention, and. A fuel cell maintainable on a high level can be constituted for the amount of electrochemical reaction which fully secures a flow of gas by each single cell which constitutes the whole fuel cell, and advances by each single cell.
[0026]Said crevice formed in the surface of a gas separator for fuel cells of this invention, it is not necessary to form a flat concave surface, and may have heights which project from a concave surface -- up to the 2nd predetermined hole from the 1st predetermined hole -- these 1st and 2nd holes -- what is necessary is just the structure of making a field top of a gas separator for fuel cells opening for free passage via a hole of an except one by one
[0027]In a fuel cell of this invention, a gas passageway in said single cell, Have a bent part in which a channel is crooked so that a flow direction of said gas which passes an inside may be changed, and said bent part, It is good also as having the 1st field that said ** style manifold penetrates, and the 2nd field that enables passage of said a part of gas which passes an inside of said bent part via said ** style manifold.
[0028]When gas which passes a gas passageway in a single cell passes a bent part in which a gas passageway in this single cell is crooked, in that part, in such a fuel cell, the remainder does not go via a ** style manifold via a ** style manifold. Thus, by providing the 2nd field that does not go via a ** style manifold, in a bent part which a ** style manifold penetrates, sufficient depth can be secured, a pressure loss at the time of gas passing the above-mentioned bent part can be stopped, and a flow of gas can be made more smooth.
[0029]In a gas separator for fuel cells of this invention, said crevice, While making said from 1st predetermined hole to the 2nd hole open for free passage on one field of said gas separator for fuel cells, having a bent part straight on this one field -- said bent part -- said 1st and 2nd holes -- it is good also as having the 1st field that one of the holes of an except penetrates, and the 2nd field in which the bottom of said crevice is formed continuously without being divided by said hole which penetrates this 1st field.

[0030]According to the gas separator for fuel cells constituted as mentioned above, the above-mentioned fuel cell and same fuel cell can be constituted, and the same effect as the above-mentioned fuel cell can be acquired in such a fuel cell.
[0031]In the above-mentioned fuel cell, said bent part is still better also as having accomplished U type. Although a gas passageway in a single cell can be effectively allocated in each single cell and a gas mass flow which passes through inside of a channel can be increased by forming a bent part in U type, In a bent part which accomplishes U type, an effect which reduces a pressure loss and makes a flow of gas smooth because a pressure loss becomes large and has the above-mentioned composition can be especially acquired notably especially by changing a flow direction of gas for reverse.
[0032]In a fuel cell of this invention, a gas passageway in said single cell, Have a bent part in which a channel is crooked so that a flow direction of said gas which passes the inside may be changed, and a

periphery of said bent part, It is formed so that it may curve smoothly, and said ** style manifold is good also as penetrating a gas passageway in said single cell in a peripheral part of said bent part.
[0033]Since gas which passes a gas passageway in a single cell will be led to a periphery which curves smoothly in a bent part and will flow if it has such composition, an effect that a flow of gas which passes a gas passageway in a single cell becomes more smooth is acquired.
[0034]In a fuel cell of this invention, a gas passageway in said single cell, Have a bent part in which a channel is crooked near the rim of said fuel cell so that a flow direction of said gas which passes the inside may be changed, and said ** style manifold, Are provided near the rim of said fuel cell, and in a peripheral part of said bent part, penetrate and a gas passageway in said single cell sectional shape of said ** style manifold, An internal surface corresponding to an end of said sectional shape which accomplishes longwise shape where a rim of said fuel cell was met, and accomplishes longwise shape among internal surfaces by the side of said fuel cell rim in said ** style manifold, Compared with an internal surface corresponding to a center section of said sectional shape, it is good also as thickness from a rim of said fuel cell being thick.
[0035]According to such a fuel cell, intensity and endurance of a fuel cell are fully securable. When a ** style manifold is formed near the rim of a fuel cell and sectional shape of a ** style manifold considers it as longwise shape where a rim of a fuel cell was met, It can stop that a field which can participate in electrochemical reaction within each single cell by forming a ** style manifold becomes small, and it becomes easy to secure gas-seal nature in a ** style manifold. However, in the above-mentioned bent part which a ** style manifold penetrates, since a flow direction of gas changes, strong stress will work between an internal surface of a ** style manifold, and a rim of a fuel cell. It will concentrate in a field corresponding to an end of a section of a ** style manifold formed in longwise shape, and especially this stress has a possibility that intensity of this field may affect intensity of the whole fuel cell. By considering a fuel cell as the above composition, intensity of a field which strong stress commits by gas which passes a bent part can fully be secured, and it becomes possible to fully secure intensity of the whole fuel cell by this.
[0036]A gas separator for fuel cells of this invention, As said crevice makes said from 1st predetermined hole to the 2nd hole open for free passage on one field of said gas separator for fuel cells, having a bent part straight on this one field near the rim of said gas separator for fuel cells -- said 1st and 2nd holes -- one of the holes of an except. Accomplish longwise shape where it was allocated near the rim of said gas separator for fuel cells, and a rim of said gas separator for fuel cells was met, and. A wall surface located in the rim side of said gas separator for fuel cells among wall surfaces which penetrate said crevice and form this hole in a peripheral part of said bent part, It is good also as being characterized by being formed compared with a portion corresponding to a center section in a portion corresponding to an end of said hole which accomplishes longwise shape, so that distance from a rim of said gas separator for fuel cells may become large.
[0037]According to the gas separator for fuel cells constituted as mentioned above, the above-mentioned fuel cell and same fuel cell can be constituted, and the same effect as the above-mentioned fuel cell can be acquired in such a fuel cell.
[0038]
[Embodiment of the Invention]In order to clarify further composition and an operation of this invention explained above, an embodiment of the invention is described based on an example below. The fuel cell which is the 1st example of this invention is a polymer electrolyte fuel cell, and is formed of the stack structure which carried out the plural laminates of the single cell. The top view showing the composition of the separator 30 with which the fuel cell of this example is provided with the exploded perspective view showing the composition of the single cell 20 which is a basic unit of the stack structure 15 from which drawing 1 constitutes the fuel cell of the 1st example, and drawing 2, and drawing 3 are the perspective views showing the appearance of the stack structure 15. First, based on drawing 1 thru/or drawing 3, the composition of a fuel cell is explained, next the situation of the flow of the gas in this fuel cell is explained.
[0039]As mentioned above, the fuel cell of this example is a polymer electrolyte fuel cell, and is

constituted by the stack structure 15 which laminated the single cell 20 which is a basic unit. As shown in drawing 1, the single cell 20 is constituted by the electrolyte membrane 31, the anode 32, the cathode 33, and the separator 30.
[0040]Here, the electrolyte membrane 31 is an ion-exchange membrane of the proton conductivity formed with solid polymer material, for example, fluororesin, and shows good electrical conductivity according to a damp or wet condition. In this example, the Nafion film (made by Du Pont) was used. The alloy which consists of platinum as a catalyst or platinum, and other metal is applied to the surface of the electrolyte membrane 31. The carbon powder which supported the alloy which consists of platinum or platinum, and other metal as a method of applying a catalyst is produced, The suitable organic solvent was made to distribute the carbon powder which supported this catalyst, a proper quantity of electrolytic solutions (for example, Aldrich Chemical, Nafion Solution) were added and pasted, and the method of screen-stenciling on the electrolyte membrane 31 was taken. Or the composition which carries out film shaping of the paste containing the carbon powder which supported the above-mentioned catalyst, produces a sheet, and presses this sheet on the electrolyte membrane 31 is also preferred.
[0041]Both the anode 32 and the cathode 33 are the gas diffusion electrodes formed by the carbon crossing woven with the thread which consists of carbon fiber. It may form by the carbon paper or carbon felt which consists of carbon fiber besides carbon crossing, and what is necessary is just to have sufficient gas diffusion nature and conductivity.
[0042]The separator 30 is formed by the gas unpenetrated conductive member, for example, the shaping carbon which compressed carbon and it presupposed gas un-penetrating. Drawing 2 is a top view showing signs that the separator 30 was seen from the field of one of these. The separator 30 is provided with six holes near [the] the circumference. That is, the pores 40, 41, and 42 which are three holes which adjoin along with this neighborhood are formed near the one side of the separator 30, and the pores 50, 51, and 52 which similarly adjoin are formed near the neighborhood which counters around here. The separator 30 equips the both sides with the crevice of predetermined shape. As shown in drawing 2, the crevice 90 which makes the pore 40 and the pore 41 open for free passage with the crooked shape, and the crevice 91 which makes the pore 41 and the pore 42 open for free passage with the shape similarly crooked are established in one field of the separator 30. Above-mentioned one field, the crevice 92 which opens the pore 50 and the pore 51 for free passage with the crooked shape similarly, and the crevice 93 which opens the pore 51 and the pore 52 for free passage with the shape similarly crooked are established also in the field of another side of the separator 30 (not shown).
[0043]As shown in drawing 1, when the separator 30 is laminated with the electrolyte membrane 31, the anode 32, and the cathode 33, forms the single cell 20 and constitutes the stack structure 15 further, each crevice forms a gas passageway between adjoining gas diffusion electrodes. Namely, the pores 40 and 41 and the crevices 90 and 91 which make the pores 41 and 42 open for free passage, The pores 50 and 51 and the crevices 92 and 93 which make the pores 51 and 52 open for free passage form the fuel gas flow route in a single cell between the surfaces of the adjoining anode 32 by forming the oxidizing gas passage in a single cell between the surfaces of the adjoining cathode 33.
[0044]When the single cell 20 is laminated and the stack structure 15 is assembled, the pore 40 with which each separator 30 is provided forms the oxidizing gas supply manifold 60 which penetrates stack structure 15 inside to the laminating direction. The pore 41 forms the ********** style manifold 61 which similarly penetrates stack structure 15 inside to the laminating direction. The pore 42 forms the oxidizing gas exhaust manifold 62 which similarly penetrates stack structure 15 inside to the laminating direction. The pore 50 forms the fuel gas supply manifold 63 which similarly penetrates the stack structure 15 to the laminating direction, the pore 51 forms the fuel gas distribution manifold 64, and the pore 52 forms the fuel gas exhaust manifold 65 (refer to drawing 2). It explains later that the gas within these gas passagewaies formed in the stack structure 15 flows in detail (see drawing 5 mentioned later).
[0045]When assembling the stack structure 15 provided with each member explained above, it piles up one by one in order of the separator 30, the anode 32, the electrolyte membrane 31, the cathode 33, and the separator 30. The stack structure 15 which arranges the collecting electrode plates 36 and 37, the

electric insulating plates 38 and 39, and the end plates 80 and 85 one by one to the both ends, and is shown in drawing 3 is completed.
[0046]the collecting electrode plates 36 and 37 -- gas, such as substantia-compacta carbon and a copper plate, -- it is formed of a conductive member [**** / un-], the electric insulating plates 38 and 39 are formed of insulation members, such as rubber and resin, and the end plates 80 and 85 are formed with metal, such as steel provided with rigidity. The output terminals 36A and 37A are formed in the collecting electrode plates 36 and 37, respectively, and an output of the electromotive force produced with the fuel cell constituted by the stack structure 15 is possible. Four pores are provided in the same position corresponding to the collecting electrode plate 36, the electric insulating plate 38, and the end plate 80. For example, the pores 70, 72, 73, and 75 are formed in the end plate 80 (refer to drawing 3). The pore 70 and the pore provided in the same position corresponding to this in the collecting electrode plate 36 and the electric insulating plate 38 form the gas passageway which is open for free passage to the oxidizing gas supply manifold 60 mentioned already, when the stack structure 15 is constituted. The pore 72 and the pore provided in the same position corresponding to this in the collecting electrode plate 36 and the electric insulating plate 38 form the gas passageway which is open for free passage to the oxidizing gas exhaust manifold 62 mentioned already, when the stack structure 15 is constituted. Similarly the pore 73 and the pore provided in the collecting electrode plate 36 and the electric insulating plate 38 corresponding to this, The pore 75 and the pore provided in the collecting electrode plate 36 and the electric insulating plate 38 corresponding to this form the gas passageway which is open for free passage to the fuel gas exhaust manifold 65 by forming the gas passageway which is open for free passage to the fuel gas supply manifold 63.
[0047]when operating the fuel cell which consists of the stack structure 15, the pore 73 with which the end plate 80 is provided, and the fuel gas feed unit which is not illustrated are connected -- hydrogen -- rich fuel gas is supplied to the inside of a fuel cell. Similarly, when operating a fuel cell, the pore 70 and the oxidizing gas feed unit which is not illustrated are connected, and the oxidizing gas (air) containing oxygen is supplied to the inside of a fuel cell. Here, a fuel gas feed unit and an oxidizing gas feed unit are devices which perform humidification and application of pressure of the specified quantity to each gas, and are supplied to a fuel cell. When operating a fuel cell, the pore 75 and the fuel gas exhaust which is not illustrated are connected, and the pore 72 and the oxidizing gas exhaust which is not illustrated are connected. It is good also as using hydrogen gas with high purity besides [which reformed and obtained hydrocarbon] hydeogen-rich gas as fuel gas.
[0048]Although the built-up sequence of each member when the stack structure 15 is constituted is as having mentioned already, in the field which touches the separator 30, a predetermined sealing member is provided in the periphery of the electrolyte membrane 31. This sealing member prevents fuel gas and oxidizing gas beginning to leak from each inside of a single cell, and it plays the role which prevents fuel gas and oxidizing gas from being mixed in the stack structure 15.
[0049]The stack structure 15 which consists of each member explained above is held where predetermined thrust is applied to the laminating direction, and a fuel cell completes it. About the composition which presses the stack structure 15, since it was not concerned, the graphic display was abbreviated to the important section of this invention. In order to hold pressing the stack structure 15, It is good also as composition which binds the stack structure 15 tight using a bolt and a nut, or the stack member housing of predetermined shape is prepared, It is good also as composition which bends the both ends of stack member housing after storing the stack structure 15 inside this stack member housing, and makes thrust act on the stack structure 15.
[0050]In the above-mentioned explanation, although it presupposed that the separator 30 is formed with the substantia-compacta carbon which compressed carbon and it presupposed gas un-penetrating, it is good also as forming according to different construction material. For example, it is good also as forming with baking body carbon or forming by a metallic member. When forming by a metallic member, it is desirable to choose the metal which has sufficient corrosion resistance. Or it is good also as covering the surface of a metallic member with the material which has sufficient corrosion resistance.

[0051]Although drawing 2 did not indicate, The separator 30 of this example is provided also with the pore for forming the cooling channel through which cooling water other than the pores 40-42 for forming the gas manifold which oxidizing gas passes, and the pores 50-52 for forming the gas manifold which fuel gas passes passes. The electrochemical reaction which advances with a fuel cell is an exoergic reaction, and is maintaining the temperature inside a fuel cell at the predetermined temperature requirement by circulating cooling water in the cooling channel formed of the above-mentioned pore. The pore for forming such a cooling channel can be provided near [in which the pores 40-42, and 50-52 are not formed / remaining] the two sides in the separator 30. Since, as for no composition about circulation of cooling water, there is the Seki straw directly with the important section of this invention, the explanation beyond this about a cooling channel is omitted.
[0052]In order to make the flow of the gas in a single cell intelligible, expressed the crevices 90 and 91 with the separator 30 shown in drawing 1 and drawing 2 like concave structure with the flat bottom, but. Two or more convex structures of the predetermined shape which projects from the bottom are actually provided in these crevices 90 and 91 and crevices 92 and 93. An example of such a convex structure provided in the crevices 90, 91, 92, and 93 is shown in drawing 4. Drawing 4 (A) is a top view showing signs that a part of pore 40 and crevice 90 were expanded, and drawing 4 (B) is a sectional view showing the situation of the A-A section in drawing 4 (A). As shown in drawing 4, two or more heights 94 which project from the bottom are formed in the crevice 90. A section is an approximately quadrangle, and each heights 94 of these are formed so that it may become same omitting each height. The end of each heights 94 has secured conductivity sufficient by the inside of a fuel cell by the field which touches the adjoining cathode 33 and touches this cathode 33, when the stack structure 15 is assembled. The oxidizing gas which passes through the oxidizing gas passage in a single cell is efficiently supplied to the catalyst bed of the electrolyte membrane 31 surface by colliding with the side of each heights 94 and being spread in the oxidizing gas passage in a single cell.
[0053]Thus, the heights 94 provided in the crevice 90, Sufficient conductivity is secured by touching a gas diffusion electrode at the end, and the gas which passes the gas passageway in a single cell which the crevice 90 forms is diffused, electrochemical reaction is efficiently presented with oxidizing gas, and it has work of raising the capacity factor of gas. The same convex structure as the heights 94 in the crevice 90 is provided also in the crevices 91, 92, and 93, and the same work is carried out. In drawing 4, although the heights 94 considered it as the section abbreviation quadrangle, they are good also as arranging the convex structure of different shape in a different position. It does not arrange dispersedly in each crevice like the heights 94, As a convex structure formed in each crevice, the convex structure of the shape of a rib continuously established along the flow direction of the gas in a channel can be formed, and it can also have composition divided into the fine slot which runs each crevice in parallel mutually, for example. When each crevice formed in the separator surface forms the gas passageway in a single cell within a fuel cell, gas just circulates between the gas manifolds formed of the pore which each crevice makes open for free passage.
[0054]Next, it explains that the fuel gas in the fuel cell provided with the above composition and oxidizing gas flow. First, oxidizing gas is explained. Drawing 5 is an explanatory view which expresses the flow of the oxidizing gas within the stack structure 15 in three dimensions. As mentioned already, the oxidizing gas feed unit formed in the fuel cell exterior, The oxidizing gas (application-of-pressure air) which is connected to the pore 70 provided in the end plate 80, and is supplied from an oxidizing gas feed unit is introduced in the oxidizing gas supply manifold 60 via the pore provided in the position to which the electric insulating plate 38 and the collecting electrode plate 36 correspond. The oxidizing gas which passes through the inside of the oxidizing gas supply manifold 60 is drawn in each single cell 20 in the gas passageway (oxidizing gas passage in a single cell) formed between the cathodes 33 contiguous to the crevice 90 with which each separator 30 is provided. From the oxidizing gas passage in a single cell, the oxidizing gas led to the oxidizing gas passage in these single cells is diffused in the catalyst bed on the electrolyte membrane 31, and electrochemical reaction is presented with it in each single cell. Here, the remaining oxidizing gas that did not participate in electrochemical reaction once goes via the ********** style manifold 61 formed of the pore 41 provided in the separator 30.

[0055]In the ********** style manifold 61, the oxidizing gas which passes each each gas passageway in a single cell gathers, and circulation becomes possible mutually. In this ********** style manifold 61, the oxidizing gas which these-gathered flows downward (refer to drawing 5). In each single cell 20, this oxidizing gas is led to the oxidizing gas passage in a single cell formed between the cathodes 33 contiguous to the crevice 91 with which each separator 30 is provided via the pore 41 with which each separator 30 is provided. From the oxidizing gas passage in a single cell, the oxidizing gas led to the oxidizing gas passage in these single cells is diffused in the catalyst bed on the electrolyte membrane 31, and electrochemical reaction is presented with it in each single cell. Here, the remaining oxidizing gas that did not participate in electrochemical reaction is discharged by the oxidizing gas exhaust manifold 62 formed of the pore 42 provided in the separator 30.
[0056]In the oxidizing gas exhaust manifold 62, in the oxidizing gas supply manifold 60, while oxidizing gas passes for reverse, the oxidizing gas discharged from the oxidizing gas passage in a single cell formed in each single cell 20 joins. If the oxidizing gas which passed the oxidizing gas exhaust manifold 62 reaches the end of the stack structure 15, it will be discharged by the oxidizing gas exhaust linked to the pore 72 via the pore 72 provided in the end plate 80, and the pore provided in the position to which the collecting electrode plate 36 and the electric insulating plate 38 correspond.
[0057]As mentioned above, although it explained that the oxidizing gas within the stack structure 15 flowed, the same may be said of the fuel gas within the stack structure 15 flowing. The fuel gas feed unit formed in the fuel cell exterior, The fuel gas which is connected to the pore 73 provided in the end plate 80, and is supplied from a fuel gas feed unit, It is introduced via the pore provided in the position to which the electric insulating plate 38 and the collecting electrode plate 36 correspond in the fuel gas supply manifold 63 formed of the pore 50 with which the separator 30 is provided. The fuel gas which passes through the inside of the fuel gas supply manifold 63 is led to the fuel gas flow route in a single cell (formed between the anodes 32 contiguous to the crevice 92) in each single cell 20, and electrochemical reaction is presented with it. The remaining gas that did not participate in electrochemical reaction among the fuel gas which passes the fuel gas flow route in a single cell in each single cell 20 once goes via the fuel gas distribution manifold 64 formed of the pore 51 provided in the separator 30. The fuel gas which went via these fuel gas distribution manifolds passes the fuel gas flow route in a single cell in each single cell 20 (formed between the anodes 32 contiguous to the crevice 93) again, and electrochemical reaction is presented with it. The remaining fuel gas that did not participate in electrochemical reaction is discharged by the fuel gas exhaust manifold 65 formed of the pore 52 provided in the separator 30, joins mutually, and passes through the inside of a fuel gas exhaust manifold for reverse in the fuel gas supply manifold 63. If such fuel gas reaches the end of the stack structure 15, it will be discharged by the fuel gas exhaust linked to the pore 75 via the pore 75 provided in the end plate 80, and the pore provided in the position to which the collecting electrode plate 36 and the electric insulating plate 38 correspond.
[0058]Although the direction into which the gas which passes an inside flows, respectively is for reverse in the above-mentioned explanation at the oxidizing gas supply manifold 60, the oxidizing gas exhaust manifold 62, and the fuel gas supply manifold 63 and the fuel gas exhaust manifold 65, It is good also as composition which gas passes in the same direction with the manifold of a supply side, and the manifold by the side of discharge. That is, the end which connects the oxidizing gas exhaust and the fuel gas exhaust and in which gas is supplied to the end-plate [not the end plate 80 but] 85 side in the stack structure 15 is better also as discharging gas than the end of an opposite hand.
[0059]According to the fuel cell provided with the separator 30 of this example constituted as mentioned above. It has the ********** style manifold and the fuel gas distribution manifold, and as the gas which passes each gas passageway in a single cell passes the gas passageway in a single cell, it once goes via these gas ** style manifold. It originates in the accuracy of the water of condensation mentioned already by this in a part of single cell which constitutes a fuel cell, and the uneven shape formed in the separator surface, Also when the flow of the gas which passes the gas passageway in a single cell has shown dispersion, the gas mass flow which passes the gas passageway in a single cell is equalized by going via a ** style manifold, and dispersion in the gas mass flow which went via the ** style manifold is

reduced. For example, in either of the single cells 20 to constitute, a fuel cell for the water of condensation, When the flow of the oxidizing gas which passes through the oxidizing gas passage in a single cell formed of the crevice 90 decreases and the oxidizing gas which passes through the inside of each single cell goes via the ********** style manifold which once gather, It is compensated with oxidizing gas from the single cell arranged in the neighborhood, and the flow of oxidizing gas becomes enough and the amount of oxidizing gas supplied in a specific single cell does not fall too much in the oxidizing gas passage in a single cell formed of the crevice 91. On the contrary, in either of the single cells 20 to constitute, a fuel cell for the water of condensation, Also when the flow of the oxidizing gas which passes through the oxidizing gas passage in a single cell formed of the crevice 91 decreases, in the oxidizing gas passage in a single cell of the upstream formed of the crevice 90, the oxidizing gas of quantity can be enough passed by being open for free passage with a ********** style manifold. Therefore, it can stop that originate in dispersion in the gas mass flow which passes each gas passageway in a single cell, and the performance of a fuel cell falls.
[0060]Drawing 6 is with the fuel cell constituted using the separator 30 of this example, and the fuel cell constituted using the separator 130 shown in drawing 8 as a comparative example, and is the explanatory view which compared current/voltage characteristics. Although the separator 130 has the almost same shape as the separator 30 of this example, The single crevice 190 which does not have the structure corresponding to the pore 41 and the pore 51, for example, is formed continuously and has three flections in one field side of the separator 130 is formed (refer to drawing 8). Therefore, the fuel cell constituted using the separator 130 does not have a ********** style manifold and a fuel gas distribution manifold, and traffic of the gas which passes each gas passageway in a single cell is not once mutually attained on the way like the above-mentioned example. In the separator 130 shown in drawing 8, to the composition which is common in the separator 30, the member number which added 100 to the member number given to the separator 30 is given, and detailed explanation is omitted in it. The heights 94 provided in the crevice 90 of the separator 30 shown in drawing 4 also in the crevice 190 of the separator 130 and the same heights are provided, and the separator 130, In an area equivalent to the case of the separator 30, conductivity shall be secured in contact with an adjoining gas diffusion electrode.
[0061]As shown in drawing 6, the fuel cell which is constituted by the separator 30 and has a ********** style manifold and a fuel gas distribution manifold, It was constituted by the separator 130, and even if output current became large compared with the fuel cell which does not have a ********** style manifold and a fuel gas distribution manifold, higher output voltage was able to be maintained. That is, the fall of the performance of a fuel cell was able to be suppressed by forming a ** style manifold and equalizing the flow of the gas which passes the gas passageway in each single cell.
[0062]The fuel cell constituted using the separator 30, When the situation where the gas flow rate which passes the gas passageway in a single cell falls in some single cells in the single cell which constitutes this fuel cell arises, The effect of equalizing the inclination of the rate of flow of the gas which passes each gas passageway in a single cell not only with the effect of equalizing the gas flow rate in the gas passageway in this single cell but with the whole fuel cell is done so. In each of the fuel cell constituted using the separator 30, and the fuel cell constituted using the separator 130, drawing 7 is an explanatory view showing the result of having investigated the distribution state of the rate of flow of the gas which passes each internal gas passageway in a single cell. Here, each fuel cell consisted of 100 sets of laminated single cells, and used the value which measured the rate of flow in case gas flows into each gas passageway in a single cell from a gas supply manifold as a rate of flow of the gas which passes through the inside of each single cell.
[0063]The rate of flow of the gas which passes through the inside of the gas passageway in a single cell allocated by the upstream (side to which gas supply device and the gas exhaust were connected) end of the fuel cell was set to 100, and the gas flow rate in the remaining gas passageway in a single cell was expressed with this drawing 7 one by one as a relative value over this. Like the example mentioned already, in connecting a gas supply device and the gas exhaust to the end of the same side of a fuel cell, as for a gas flow rate, the upstream which is this connected end becomes late gradually towards the end

of an opposite hand (downstream) in a gas flow rate early most. Also in the fuel cell constituted using the separator 30, although a gas flow rate (going to the cell-numbers 100 side from the cell-numbers 1 side in drawing 7) becomes slow toward the above-mentioned upstream to the downstream, As shown in drawing 7, compared with the fuel cell constituted using the separator 130 which is a comparative example, the grade to which a gas flow rate becomes slow toward the downstream is small.
[0064]Thus, according to the fuel cell using the separator 30 of this example, the inclination of the rate of flow of the gas which passes through each channel in a single cell becomes small, and with the whole fuel cell. Since the rate of flow of the gas which passes the gas passageway in a single cell is maintained at a high level, also in the single cell allocated in the above-mentioned downstream, the capacity factor of gas becomes high enough. Therefore, as shown in drawing 6 mentioned already, it is possible that it is that the fuel cell using the separator 30 shows high battery capacity also in the effect that gas flow rate sufficient with the whole fuel cell in this way is maintained.
[0065]When the rate of flow of the gas which passes through each channel in a single cell with the whole fuel cell becomes quick, It can say that enough many flows of gas are maintained with the whole fuel cell, and the grade which pressurizes the gas supplied to a fuel cell in order to fully secure the gas mass flow in the field whose gas mass flow decreases most can be suppressed. When the capacity factor of gas becomes high enough with the whole fuel cell, the effect that the flow of the gas supplied to a fuel cell can be reduced is also acquired. In order to fully advance electrochemical reaction, the gas of the quantity exceeding the requirements of the gas theoretically calculated from the electric energy made to generate is usually supplied to a fuel cell. If the capacity factor of gas increases as described above, the gas volume supplied superfluously in this way can be stopped. By the ability to suppress the grade of the application of pressure of the gas volume supplied to a fuel cell, and gas, The electric energy consumed in order to stop the quantity of the fuel consumed for power generation or to pressurize the gas supplied to a fuel cell can be suppressed, and the energy efficiency of the whole system provided with a fuel cell can be raised.
[0066]When gas passes the gas passageway in each single cell provided in each single cell in the fuel cell using the separator 30 in the above-mentioned example, gas flows into an abbreviated horizontal direction according to the shape of the crevice established in the separator surface, but. In each whole gas passageway in a single cell, gas flows into a lower part from the upper part. For example, oxidizing gas flows toward the lower part in which the pore 42 was formed from the upper part in which the pore 40 was formed. Therefore, since the water of condensation produced in the gas passageway is also caudad led with the flow of gas, without opposing gravity, wastewater of the water of condensation from the gas passageway in a single cell becomes easy. Here, with the water of condensation produced in a channel, as mentioned already, the produced water which is produced in the cathode side in connection with electrochemical reaction and which was mentioned already, the steam beforehand added to distributed gas in order to prevent desiccation of an electrolyte membrane to a fuel cell before supplying gas, etc. condense within a gas passageway.
[0067]In the fuel cell using the separator 30 of this example, the gas manifold is provided in the side of the fuel cell, and the gas supplied to each single cell flows in sideways to each gas passageway in a single cell. Therefore, it can stop that the water of condensation produced in the gas manifold takes up near a terminal area with the gas manifold in each gas passageway in a single cell, and bars the flow of gas. On the other hand, when the gas manifold is provided in the upper and lower sides of the fuel cell and gas is supplied from an upper gas manifold to each gas passageway in a single cell, the water of condensation in this gas manifold flows into the gas passageway in a single cell easily, and there is a possibility of blockading a gas passageway.
[0068]In the separator 30 of the example mentioned already, the surface is quadrisected horizontally, In the field side which every two divided fields were made to continue, for example, was shown in drawing 2, we considered it as the crevice 90 and the crevice 91, and decided to form the single ********** style manifold 61 by the pore 41 which makes these crevices 90 and 91 open for free passage. Here, an oxidizing gas (or fuel gas) ** style manifold is good also as providing more than one, and is shown in drawing 9 by making an example of the separator of such composition into the separator 230. Although

the surface of one of these is horizontally quadrisected like the separator 30, the separator 230 shown in drawing 9, When this divided field forms four respectively separate crevices (crevice 290,291,292,293) and a fuel cell is constituted using the separator 230, these crevices form the oxidizing gas passage in a single cell between adjoining gas diffusion electrodes. The separator 230 is provided with five pores (pores 240 and 241,242,243,244). When a fuel cell is constituted using the separator 230, these pores form the gas manifold which oxidizing gas passes.

[0069]Here, the pore 240 forms an oxidizing gas supply manifold, and this oxidizing gas supply manifold distributes the oxidizing gas supplied from the outside to the gas passageway in each single cell. The pore 242 forms an oxidizing gas exhaust manifold, and this oxidizing gas exhaust manifold makes the oxidizing gas discharged from the channel in each single cell join, and it leads it to the exterior of a fuel cell. The pore 241,243,344 forms a ********** style manifold and the oxidizing gas which passes through the oxidizing gas passage in each single cell formed in the single cell which constitutes a fuel cell once goes via each of these ********** style manifolds, respectively.

[0070]The crevice 291 makes the pore 243 and the pore 241 open for free passage, the crevice 292 makes the pore 241 and the pore 244 open for free passage, and the crevice 293 makes the pore 244 and the pore 242 for the above-mentioned crevice 290 to make the pore 240 and the pore 243 open for free passage, and open for free passage. Therefore, the oxidizing gas supplied from the outside is first introduced into the oxidizing gas passage in a single cell formed of the crevice 290 via the oxidizing gas supply manifold formed of the pore 240. The oxidizing gas which passed through the oxidizing gas passage in this single cell passes through the oxidizing gas passage in a single cell formed of the crevice 291, after going via the ********** style manifold formed of the pore 243. Then, repeat the same operation and it goes via the ********** style manifold formed of the pore 241, After going via the ********** style manifold which passes through the oxidizing gas passage in a single cell formed of the crevice 292, and is formed of the pore 244, It passes through the oxidizing gas passage in a single cell formed of the crevice 293, and is discharged by the exterior of a fuel cell via the oxidizing gas exhaust manifold formed of the pore 242.

[0071]According to the fuel cell constituted using such a separator 230, equalize the flow of the oxidizing gas supplied to the gas passageway in each single cell like the above-mentioned example using the separator 30, and. The rate of flow of gas can be kept high enough with the whole fuel cell, and it can prevent the performance of a fuel cell falling. Since there are many ********** style manifolds compared with the case where the separator 30 is used especially, the effect which equalizes the flow of the oxidizing gas which passes through the inside of each single cell can be heightened further.

[0072]Although we decided to form a gas ** style manifold by both the channel of oxidizing gas, and the channel of fuel gas in the fuel cell using the separator 30 of the example mentioned already, It is good also as providing only in one of channels, and a suitable effect is acquired also when such a gas ** style manifold is formed in one of channels. Although we decided that the manifold which fuel gas passes provides only a couple and a gas ** style manifold is formed only in the oxidizing gas passage side in the separator 230 shown in drawing 9, the above-mentioned effect by equalizing the flow of oxidizing gas also in such a case can fully be acquired. The above-mentioned effect by the flow of fuel gas equalizing from the first also as forming a ** style manifold only in the fuel gas flow route side can be acquired. In forming a gas ** style manifold only in one of channels, in order to form a gas ** style manifold in the gas passageway of another side, it is not necessary to provide a pore, and shaping of a separator becomes easier.

[0073]Although the surface of the separator was horizontally quadrisected in the example mentioned already, it is good also as dividing the separator surface into a different number and forming a gas ** style manifold. Such an example is shown below. Drawing 10 is a top view showing the composition of the separator 330 which divided the separator surface into two horizontally. In the fuel cell constituted using the separator 330, the oxidizing gas passage in a single cell is formed of the crevice 390,391 which divided the surface of the separator 330 two and was provided. moreover -- such a fuel cell -- of the pore 342, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore

340, it is formed, and a ********** style manifold is formed of the pore 343. The oxidizing gas distributed to each single cell from the oxidizing gas supply manifold, It passes through the oxidizing gas passage in a single cell which the crevice 390 forms, the gas passageway in a single cell which the crevice 391 forms after that is passed via [a ********** style manifold] once, and it is discharged outside via an oxidizing gas exhaust manifold.
[0074]The top view showing the composition of the separator 430 which trichotomized the separator surface is shown in drawing 11. In the fuel cell constituted using the separator 430, the oxidizing gas passage in a single cell is formed of the crevice 490,491,492 which trichotomized the surface of the separator 430 horizontally and was provided. moreover -- such a fuel cell -- of the pore 442, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 440, it is formed, and a ********** style manifold is formed of the pore 443,444. The oxidizing gas distributed to each single cell from the oxidizing gas supply manifold passes through the oxidizing gas passage in a single cell which each of the crevice 490,491,492 forms one by one. In that case, it goes via the ********** style manifold which makes the continuous oxidizing gas passages in [of two] a single cell open for free passage one by one. The oxidizing gas which passed the gas passageway in a single cell which the crevice 492 forms is discharged outside via an oxidizing gas exhaust manifold.
[0075]Drawing 12 is a top view showing the composition of the separator 530 which divided the separator surface into six. One surface of the separator 530 is made open for free passage, respectively, three of every fields which divided the surface of the separator 530 into six horizontally are provided in it, and the crevice 590,591 which has two flections, respectively is established in it. In the fuel cell constituted using the separator 530, the oxidizing gas passage in a single cell is formed of these crevices 590,591. moreover -- such a fuel cell -- of the pore 542, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 540, it is formed, and a ********** style manifold is formed of the pore 543. The oxidizing gas distributed to each single cell from the oxidizing gas supply manifold, It passes through the oxidizing gas passage in a single cell which the crevice 590 forms, the gas passageway in a single cell which the crevice 591 forms after that is passed via [a ********** style manifold] once, and it is discharged outside via an oxidizing gas exhaust manifold. Although the pore for forming a ********** style manifold decided to provide only one place in the separator 530, in order to form two or more ********** style manifolds, it is good also as providing many pores. For example, it is good also as providing a pore in the flection which the crevice 590 and the crevice 591 have, and forming a ********** style manifold further by such a pore.
[0076]Thus, by dividing the separator surface into two or more fields, forming the crevice for forming the gas passageway in a single cell, and forming a gas ** style manifold by these crevices and a pore open for free passage, The flow of the gas which passes the gas passageway in a fuel cell can be equalized, and the effect mentioned already can be acquired. Although while showed drawing 10 - drawing 12 and the above explanation explained the field side, i.e., an oxidizing gas passage, to them, Also about the fuel gas flow route provided in another field side, by having same composition, the flow of the gas which passes a gas passageway can be equalized and the performance of a fuel cell can be raised. Here, shape of the crevice formed in the separator surface is made fine, the gas mass flow which passes the position of the gas passageway in a single cell increases, the diffusibility of gas improves, and the rate of gas utilization increases, so that the cross-section area of the gas passageway formed of such a crevice is made small. Since the water of condensation becomes is easy to be blown away and the water of condensation becomes difficult to stagnate in the gas passageway in a single cell so that the gas mass flow which passes the gas passageway in a single cell increases and a gas flow rate becomes quick, the wastewater nature in the gas passageway in a single cell improves. However, if a passage sectional area is made small in this way, the pressure loss at the time of gas passing the gas passageway in a single cell will also go up. The energy required in order that the rise of the pressure loss at the time of gas passing may pressurize the gas supplied to a fuel cell is made to increase, and there is a possibility of leading to decline in the energy efficiency of the whole system provided with a fuel cell. Therefore, what is necessary is just to determine the fineness of the shape of a crevice suitably in consideration of the effect that the rate of gas utilization improves by making it fine, the process tolerance demanded

when forming the influence of the pressure loss which increases by this, and a separator, etc.
[0077]The crevice formed in the separator surface in order to form the gas passageway in a single cell is made to diffuse the gas which passes through a channel in explanation of the separator 30, as shown in drawing 4, and two or more heights which secure conductivity between a separator and a gas diffusion electrode are provided in it. Here, if the shape of the crevice established in the separator surface is fine enough and the diffusibility of gas and the conductivity between gas diffusion electrodes are fully secured, it is not necessary to establish such a convex structure corresponding to the heights 94 in a crevice.
[0078]Although the all once considered the gas which passes the gas passageway in a single cell formed of the predetermined crevice established in the separator surface via the gas ** style manifold in the example mentioned already as the composition which flows into each single cell again after that, A part of gas which passes the gas passageway in a single cell is good also as composition which does not go via a gas ** style manifold. As an example of such composition, the composition (composition by the side of the field which forms an oxidizing gas passage) of the separator 630 is shown in drawing 13. The separator 630 is provided with the crevice 690 which quadrisected the surface horizontally and made these open for free passage one by one, and the pore 640,641,642. In the fuel cell constituted using the separator 630. After the oxidizing gas supplied to each single cell from the oxidizing gas supply manifold formed of the pore 640 passes through the oxidizing gas passage in a single cell formed of the crevice 690, it is discharged by the oxidizing gas exhaust manifold formed of the pore 642, and is drawn out of a fuel cell.
[0079]Here, the crevice 690 which forms the oxidizing gas passage in a single cell is a field where the shape is crooked on the separator 630, and is open for free passage with the pore 641 which forms a ********** style manifold. In the separator 30 of the example mentioned already, although the crevices 90 and 91 are open for free passage via the pore 41, they are divided by the pore 41 as a structure of a crevice. The crevice 690 with which the separator 630 is provided is not necessarily divided by the pore 641 in this way, and is opening from the pore 640 to the pore 642 for free passage by the crevice structure formed continuously. That is, although the pore 641 is open for free passage with this crevice 690 in the end (outside of crookedness) at which the crevice 690 is crooked and it is formed along with one side of the separator 630, the crevice is formed continuously, without the field (inside of crookedness) which adjoins the pore 641 being divided by the pore 690. Therefore, although a part of oxidizing gas which passes through the oxidizing gas passage in a single cell once goes via the ********** style manifold formed of the pore 641 on the way, Without going via a ********** style manifold, the remaining oxidizing gas passes through the oxidizing gas passage in a single cell which the crevice 690 forms, and is discharged by the oxidizing gas exhaust manifold. In drawing 13, although only the situation by the side of one field of the separator 630 (side which forms the oxidizing gas passage in a single cell) was shown, the field side (side which forms the fuel gas flow route in a single cell) of another side is formed similarly. Namely, the fuel gas supplied to each single cell from the fuel gas supply manifold, Can draw the fuel gas flow route in a single cell which the crevice 690 and the same crevice form, and the part goes via the fuel gas distribution manifold which the pore 641 and the same pore form, and. The remaining fuel gas is drawn to a fuel gas exhaust manifold by the fuel gas flow route in a single cell which the above-mentioned crevice forms, without going via a fuel gas distribution manifold.
[0080]According to the separator 630 of such composition, in the field in which a crevice (gas passageway in a single cell) is crooked. By passing a part of gas which passes the gas passageway in a single cell, without making it go via a ** style manifold, the pressure loss of the gas in such a flection can be stopped, and the bias of the flow of gas can be stopped. As mentioned already, when the composition which makes small the passage sectional area of the gas passageway in a single cell formed on a separator increases the gas mass flow and the rate of flow which pass through the inside of a channel, it is useful. However, in order to make a passage sectional area small, when providing a flection (part which changes the flow direction of gas) in the gas passageway in a single cell like the example mentioned already, in such a flection, the pressure loss of gas becomes large, and the flow of

gas will be confused and a bias will be produced with a flow. Although what is necessary is just to expand the depth in a flection in order to reduce the pressure loss in a flection, in order to expand the depth in a flection, it is necessary to enlarge a pore with the composition which divides a crevice by a pore like the example mentioned already. Such composition will enlarge area of a pore to the whole separator, and the rate of an available area falls to electrochemical reaction, and it cannot adopt it as it easily. If it has composition which a crevice follows by the inside of a flection like the above-mentioned separator 630, it can suppress that can fully secure the depth in a flection, without enlarging area of a pore, a channel is narrowed down by a flection, and a pressure loss increases.
[0081]The separator 630 which established the communicating structure whose passage of gas is attained without drawing 14 going via a gas ** style manifold in the flection of the gas passageway in a single cell, It is a fuel cell using each with the separator 30 which divided the crevice by the pore by the above-mentioned flection, and is an explanatory view showing the result of having carried out the simulation of signs that gas flows. Drawing 14 (A) expresses the result of having used the separator 630, drawing 14 (B) expresses the result of having used the separator 30, and all express the pressure distribution in a gas ** style manifold on the field of a predetermined separator. As shown in drawing 14 (B), in using a separator provided with the crevice divided by the pore, within the gas ** style manifold which a pore forms, a very high pressure arises and the pressure loss at the time of gas passing the gas passageway in a single cell by this becomes large. On the other hand, as shown in drawing 14 (A), when using a separator provided with the crevice which has the communicating structure which can pass gas, without going via a ** style manifold, the pressure produced within a gas ** style manifold is reduced, and the pressure loss at the time of gas passing the gas passageway in a single cell is stopped.
[0082]Although drawing 14 showed only the pressure distribution in a gas ** style manifold, In the gas passageway in a single cell connected to a gas ** style manifold by adjoining a gas ** style manifold and establishing the above-mentioned communicating structure, the effect of a pressure loss being stopped and also being hard to produce the bias of the flow of gas is acquired. Producing a high pressure especially by the predetermined part in a gas ** style manifold, as shown in drawing 14 (B). If the pressure loss of the gas at the time of passing through the inside of a ** style manifold is large, in the downstream of a gas ** style manifold, a bias will arise with the flow of gas -- the field to which the rate of flow of gas falls remarkably produces. Thus, if the flow of gas becomes uneven by the gas passageway in a single cell, the efficiency in which electrochemical reaction advances will vary by a place. If a gas ** style manifold is adjoined and the above-mentioned communicating structure is established like [in the case of using the separator 630], it can stop that a bias arises with the flow of gas, and the efficiency of electrochemical reaction can fully be secured on the field of the whole separator.
[0083]Also when the composition which adjoins a gas ** style manifold like the separator 630, and establishes the above-mentioned communicating structure miniaturizes a fuel cell more, it is effective. Namely, although the composition which makes the pore for forming a gas manifold smaller as composition which miniaturizes a fuel cell can be considered without reducing battery capacity, If a gas ** style manifold is adjoined and the above-mentioned communicating structure is established, even if it makes a pore small in this way, the pressure loss at the time of gas passing can become large too much, and it is sufficient, and can stop that the inconvenience that the flow of gas worsens arises. In such a case, since a part of gas which passes the gas passageway in a single cell goes via a gas ** style manifold, miniaturizing a fuel cell, can acquire the effect which equalizes a gas mass flow, and. By not going via a gas ** style manifold, the remaining gas can secure the flow of sufficient gas.
[0084]In the separator of the example mentioned already, the gas passageway in a single cell which the crevice provided on the separator forms is open for free passage with the gas ** style manifold in the flection by which the flow direction of the gas which passes through the inside of this channel is changed. Here, the pore which is provided in a separator and forms a gas ** style manifold within a fuel cell is formed along with the predetermined neighborhood in the periphery of a separator. In such a separator, it is also desirable for the distance of the rim of a separator and the above-mentioned pore to have composition which becomes large in the end of a pore. Such composition is explained using

drawing 15.

[0085]Drawing 15 (A) expresses the composition to which the distance of the rim of a separator and the above-mentioned pore becomes large in the end of a pore, and drawing 15 (B) expresses composition with a constant distance of the rim of a separator, and the above-mentioned pore. Although drawing 15 expresses only the neighborhood of the end of the pore which forms a gas ** style manifold among the structures of a separator, The separator shown in drawing 15 (B) was the same as the separator 30 of the example mentioned already, and it has the same composition as the separator 30, and other parts which the separator 30A shown in drawing 15 (A) does not illustrate, either gave the same number as the separator 30 to the common member, and omitted explanation. The separator 30A is provided with the pore 41A which forms a ********** style manifold like the pore 41 in the separator 30. In the end of the pore 41A, only the side near the rim of the separator 30A inclines gently inside the separator 30A, and the periphery of the pore 41A is formed so that the end of the pore 41A may become thin gradually by this.

[0086]According to the separator 30A constituted in this way, the fuel cell which was more excellent in endurance can be constituted. As mentioned already, in forming a gas ** style manifold by the pore provided in the separator, In order that the gas which passes the gas passageway in a single cell may change a flow direction in the flection of the gas passageway in a single cell in which the gas ** style manifold was formed (refer to the solid line arrow in drawing 15 (B)), In each separator which constitutes a fuel cell, the power of going to the outside direction of a separator works in the pore which forms a gas ** style manifold (refer to the dashed line arrow in drawing 15 (B)). Especially in the separator peripheral area near the end of the pore which forms a gas ** style manifold, such outward stress is concentrated and committed with each separator. Thus, the position which power concentrates and is committed is illustrated in the separator 30 of drawing 15 (B). Although enlargement of a fuel cell is suppressed by bringing the pore 41 close to the rim of the separator 30 as much as possible, and providing, Thus, if distance of the pore 41 and a separator rim is made small, as shown in drawing 15 (B), stress will concentrate on a thin member, and it will become a problem when fully securing the intensity and endurance of a fuel cell. If the pore 41A is formed like the separator 30A shown in drawing 15 (A) so that distance with the rim of a separator may become large in the end, sufficient intensity to the above-mentioned stress can be realized, and the endurance of a fuel cell can fully be secured. As described above, in order to attain desired intensity according to the composition to which the shape of the pore 41A is made for distance with the rim of a separator to become large in the end, without forming the whole pore 41A in the distance more from a separator rim, In order to secure the intensity of a separator, the whole separator and by extension, the whole fuel cell are not enlarged.

[0087]When forming the shape of the pore 41A so that distance with the rim of a separator may become large in the end, as shown in drawing 15 (A), If only the side near the rim of the separator 30A among the peripheries of the pore 41 considers it as the shape which inclines gently inside the separator 30A as it goes to the end of the pore 41, the gas which passes the gas passageway in a single cell is led to this shape that inclines gently, and it can be more smoothly flowed through it. Like drawing 15 (B), if the corner is formed in the end of the pore 41, the gas which passes the flection of the gas passageway in a single cell will produce a turbulent flow in this corner, and the pressure loss of gas will become still larger by this. By forming a channel like drawing 15 (A) in accordance with the direction into which gas flows, such a pressure loss can be stopped and the flow of gas can be made smooth. Although the channel side of oxidizing gas was expressed with drawing 15, the above-mentioned effect can be acquired by forming a gas ** style manifold in the channel side of fuel gas by a same-shaped pore. Although only one side was expressed with drawing 15 among the ends of the pore which forms a gas ** style manifold, the above-mentioned effect of securing the intensity of a separator and making the flow of gas smooth can be further enlarged by considering it as the shape which described both ends above.

[0088]Although the pore which forms a gas ** style manifold decided that the flection of the crevice which forms the gas passageway in a single cell, i.e., near the peripheral part of a separator, provides in the example mentioned already, Even if it forms a gas ** style manifold by the pore provided in the field

to which separators differ, the effect which equalizes the rate of flow of the gas which passes a gas passageway can be acquired. An example of such composition is shown in drawing 16 and drawing 17 as the separator 730 and the separator 830, respectively.

[0089]Drawing 16 is a top view showing the composition (composition by the side of the field which forms an oxidizing gas passage) of the separator 730. The surface of the separator 730 is quadrisected horizontally and the crevice 790,791,792,793 is established in each divided field. In the fuel cell constituted using the separator 730. The crevice 790,791,792,793 established in the surface of the separator 730, This order is open for free passage, the oxidizing gas passage in a single cell is formed, of the pore 742, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 740, it is formed, and a ********** style manifold is formed of the pore 743,744,745.

[0090]Although the pore 743 makes the crevices 790 and 791 open for free passage, the pore 744 makes the crevices 791 and 792 open for free passage here and the pore 745 is making the crevices 792 and 793 open for free passage, Unlike the pore which forms a gas ** style manifold in the example mentioned already, these pores are provided in the central part twist from that of the separator. That is, it does not provide in the flection projected toward the separator peripheral part from the crevice established in the separator surface, but it is provided so that the end sides of the crevice which adjoins each other may be opened for free passage (refer to drawing 16).

[0091]Drawing 17 is a top view showing the composition (composition by the side of the field which forms an oxidizing gas passage) of the separator 830. The surface of the separator 830 is trichotomized horizontally, near [the] the 2nd step of middle forms the crevice 890 continuously with the first step, and even the 3rd step forms the crevice 891 continuously from near the 2nd step of middle. As for the connection section of the crevice 890 and the crevice 891, i.e., near the central part of the separator 830, the pore 843 which makes these crevices open for free passage is formed (refer to drawing 17). In the fuel cell constituted using the separator 830. This order is open for free passage, and the crevice 890,891 established in the surface of the separator 830 forms the oxidizing gas passage in a single cell, Of the pore 842, an oxidizing gas supply manifold forms an oxidizing gas exhaust manifold by the pore 840, it is formed, and a ********** style manifold is formed of the pore 843.

[0092]Although we decided to form such a gas ** style manifold only in the channel side of oxidizing gas in the separators 730 and 830 shown in drawing 16 and drawing 17, it is good also as forming the same gas ** style manifold also as the channel side of fuel gas.

[0093]Thus, the pore which forms a gas ** style manifold, The gas ** style manifold good also as providing in which field on a separator and formed of a pore, If the gas which is open for free passage with the gas passageway in each single cell formed of the crevice established in the separator surface, and passes through the inside of each single cell is able to once go via this gas ** style manifold, The effect of making the flow of the gas which passes the gas passageway in a fuel cell equalizing can be acquired. Therefore, it adds to the number of partitions on the separator for providing a crevice, or the number of ** style manifolds, They can be designed freely, the position of the pore for forming a ** style manifold, etc. taking into consideration suitably the energy efficiency of the whole system provided with a fuel cell, the restrictions on the space in which a fuel cell should be installed, etc.

[0094]As for this invention, although the example of this invention was described above, it is needless to say that it can carry out with the aspect which becomes various within limits which are not limited to such an example at all and do not deviate from the gist of this invention.

[Translation done.]

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3.In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, in the gas separator for fuel cells indicated by above-mentioned drawing 18 and gazette. The hole which the gas supplied to the gas passageway in this single cell passes in the gas passageway in a single cell with which each single cell is provided (drawing 18 the pore 940 and the pore 950), And since there was only one hole (drawing 18 the pore 942 and the pore 952) which the gas discharged from the gas passageway in a single cell passes at a time, respectively, there was a problem that there was a possibility that the ** style of gas to each single cell which constitutes a fuel cell may become uneven. For example, when the produced water etc. which are produced in connection with electrochemical reaction condense in the channel of gas, if this water of condensation stagnates near the terminal area of a gas manifold and the gas passageway in a single cell, and in the gas passageway in a single cell, The resistance to the flow of gas will arise in the gas passageway in a single cell corresponding to the part in which this water of condensation stagnated, and the flow of gas will be barred. Thus, by the single cell in which the supply state of gas got worse, since electrochemical reaction will not fully advance, with the whole fuel cell, output voltage shows dispersion between each single cell, and there is a possibility that the performance of a fuel cell may fall.

[0009]Here, the water of condensation produced in a gas passageway is explained. The water of condensation produced all over the channel of oxidizing gas originates in the produced water produced in the cathode side in connection with electrochemical reaction. Below, the electrochemical reaction which advances by each single cell which constitutes a polymer electrolyte fuel cell is expressed.
[0010]
H_2-> $2H^+$+$2e^-$ -- (1)
(1/2) O_2+$2H^+$+$2e^-$ -> H_2O -- (2)
H_2+(1/2) O_2-> H_2O -- (3)
[0011](1) The reaction which a formula shows the reaction [reaction / by the side of an anode] by the side of a cathode of (2) types, and is shown in (3) types as the whole cell advances. Thus, in a polymer electrolyte fuel cell, produced water arises by the cathode side with advance of a cell reaction. Although the produced produced water is evaporated in the oxidizing gas currently supplied to the cathode side and it is discharged out of a fuel cell with oxidizing gas, When the field where temperature is low is all over the time with many amounts of produced water, and the channel through which oxidizing gas flows selectively, produced water may condense in the channel of oxidizing gas, and the water of condensation may stagnate in a channel.
[0012]In the anode side, although produced water does not arise in connection with electrochemical reaction, the fuel gas supplied to the anode side usually humidifies beforehand, before supplying a fuel cell. Namely, when the reaction shown in the above-mentioned (1) formula by the anode side advances, the produced proton will be in the state where water runs short, by the anode side of a solid electrolyte in order to move toward the cathode side in the state where it hydrated with the water molecule in the inside of a solid-electrolyte membrane, but. Dryness of a solid electrolyte has prevented desiccation of

the solid-electrolyte membrane by supplying the fuel gas usually beforehand humidified as described above in order to reduce the conductivity of a solid electrolyte. Therefore, the steam added to this fuel gas may condense in the channel of fuel gas. Thus, when the water of condensation produced in the channel of oxidizing gas or the channel of fuel gas stagnates and the supply state of gas gets worse in some single cells, there is a possibility that the performance of the whole fuel cell may get worse.

[0013]The problem that output voltage will vary between each single cell which constitutes a fuel cell may originate in the accuracy at the time of the above-mentioned water of condensation becoming a cause, and also fabricating the gas separator for fuel cells, and may be produced. In order to form a gas passageway, when the accuracy of shaping is insufficient in the rugged structure formed in the gas separator surface (i.e., when the depth of the formed unevenness has dispersion), The passage resistance at the time of gas passing the gas passageway in a single cell will vary for every single cell, and the gas volume supplied for every single cell will vary. Therefore, it originated in the accuracy at the time of fabricating a gas separator in the fuel cell using the gas separator known conventionally, output voltage varied between each single cell, and there was a possibility that the performance of the whole fuel cell might get worse.

[0014]The distribution method of the gas in the gas separator for fuel cells, fuel cell, and fuel cell of this invention solved such a problem, was made for the purpose of preventing battery capacity from the flow of the gas which passes through the inside of each single cell becoming uneven, and falling, and took the next composition.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is an exploded perspective view showing the composition of the single cell 20 which is a basic unit of the stack structure 15 which constitutes the fuel cell of the 1st example.
[Drawing 2]It is a top view showing the composition of the separator 30.
[Drawing 3]It is a perspective view showing the appearance of the stack structure 15.
[Drawing 4]It is an explanatory view showing the situation of the heights 94 provided in the crevice 90.
[Drawing 5]It is an explanatory view which expresses the flow of the oxidizing gas within the stack structure 15 in three dimensions.
[Drawing 6]It is an explanatory view showing the current/voltage characteristics in the fuel cell constituted using each of the separator 30 and the separator 130.
[Drawing 7]In the fuel cell constituted using each of the separator 30 and the separator 130, it is an explanatory view showing the situation of the rate-of-flow relative value in each single cell which constitutes a fuel cell.
[Drawing 8]It is a top view showing the composition of the separator 130 used as a comparative example.
[Drawing 9]It is a top view showing the composition of the separator 230.
[Drawing 10]It is a top view showing the composition of the separator 330.
[Drawing 11]It is a top view showing the composition of the separator 430.
[Drawing 12]It is a top view showing the composition of the separator 530.
[Drawing 13]It is a top view showing the composition of the separator 630.
[Drawing 14]It is an explanatory view showing the result of having carried out the simulation of the situation of the flow of the gas in a gas ** style manifold.
[Drawing 15]It is an explanatory view showing the composition of the end of the pore which forms a gas ** style manifold.
[Drawing 16]It is a top view showing the composition of the separator 730.
[Drawing 17]It is a top view showing the composition of the separator 830.
[Drawing 18]It is a top view showing the composition of the separator 930 which is an example of a separator known conventionally.
[Description of Notations]
15 -- Stack structure
20 -- Single cell
30 -- Separator
31 -- Electrolyte membrane
32 -- Anode
33 -- Cathode
36, 37 -- Collecting electrode plate
36A, 37A -- Output terminal
38, 39 -- Electric insulating plate

40-42 -- Pore
50-52 -- Pore
60 -- Oxidizing gas supply manifold
61 -- ********** style manifold
62 -- Oxidizing gas exhaust manifold
63 -- Fuel gas supply manifold
64 -- Fuel gas distribution manifold
65 -- Fuel gas exhaust manifold
70, 72, 73, 75 -- Pore
80, 85 -- End plate
90, 91, 92, 93 -- Crevice
94 -- Heights
130 -- Separator
190 -- Crevice
230 -- Separator
240, 241,242,243,244 -- Pore
290,291,292,293 -- Crevice
330 -- Separator
340,342,343 -- Pore
390,391 -- Crevice
430 -- Separator
440,442,443,444 -- Pore
490,491,492 -- Crevice
530 -- Separator
540,542,543 -- Pore
590,591 -- Crevice
630 -- Separator
640-642 -- Pore
690 -- Crevice
730 -- Separator
740,742,743-745 -- Pore
790-793 -- Crevice
830 -- Separator
840,842,843 -- Pore
890,891 -- Crevice
930 -- Separator
940,942,950,952 -- Pore
990 -- Crevice

[Translation done.]